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Volume 90 April, 1916 No. 4

How Can the Car Designer Improve?

It is not unusual to hear the car designer severely criticized by those who have to do with the maintenance of cars or their use in service. Some classes of equipment spend too much time on the repair track, others may be too heavy in comparison with the revenue load which they will carry to be satisfactory to the operating department. Sometimes the cost of repairs could have been reduced if certain details had been a little differently arranged. In what way do you think the car designer can improve these conditions? Do you think there is a sufficiently close relationship between the drafting room and the departments using and repairing the cars? Do the assumptions upon which the design for strength is based approach sufficiently close to actual service conditions to be reliable? We will award prizes of $10 each for the three best letters discussing any one or all of these questions, or offering any suggestions as to how the car designer can make his work more effective. These letters should not exceed 1,000 words each and must be received at our office, Woolworth Building, New York, not later than June 1, 1916. They will be judged entirely upon the merits of the practical suggestions offered.

What is Heat-Treated Steel?

On page 111 of the March number we announced a competition on heat-treated steel, what it is and how it should be handled. This is an opportunity for the man who is familiar with the practices connected with the preparation of this material to tell what he knows for the benefit of the man who has not been able to familiarize himself with them. Modern locomotive design necessitates the use of special materials in order to obtain both lightness and strength and heat-treated steel is coming to the front as a material which will meet these requirements. It follows naturally that railway mechanical men in general and smith shop foremen in particular, must know considerable about its characteristics if they are to have the desired success in repair work where heat-treated steel is concerned. For the two best articles on this subject we will give a first prize of $35 and a second prize of $25, the articles to be judged from a practical standpoint. They must be received in our offices in the Woolworth Building, New York, on or before May 1, 1916. For other articles which are accepted for publication we will pay at our regular space rates.

The Apprentice Competition

Thirty-seven letters were received in the competition for apprentices, in which they were urged to make practical suggestions as to the value of the efforts which were being made to train and educate them and as to how in their opinion these methods could be improved. The first prize of $15 has been awarded to J. C. Bowman, an apprentice at the Avis shops of the New York Central at Jersey Shore, Pa. The second prize of $10 has been awarded to E. C. Crawford, a machinist apprentice at the Drifton, Pa., shops of the Lehigh Valley Coal Company. Of the 37 contributions, 27 were received from the apprentices of the Lehigh Valley Coal Company at Drifton, Pa. Undoubtedly this is due to the interest which the superintendent of the shops, J. Campbell, took in a competition last fall on "How Can You Help the Apprentice?" Mr. Campbell's article was published on page 531 of the October, 1915, issue. Of the 10 other contributions four were received from apprentices on the Santa Fe and two from apprentices on the New York Central. Both of these roads have given more than ordinary attention to modern apprenticeship methods. The Baltimore & Ohio, Canadian Pacific, Erie and Southern Railway were each represented by a contributor. Several of the contributions are published on another page of this issue and contain excellent suggestions which are well worth thoughtful consideration on the part of those who have to deal with the apprentice question.

Shop Improvement Committee

For the purpose of developing more efficient methods in the repairs of cars and locomotives, some railways have formed shop improvement committees, which make a study of shop practices in the various shops of their own roads and in some noteworthy shops on other roads. The results of these studies have always been satisfactory and conditions have been so improved as to cause marked increases in efficiency. It is a splendid practice to adopt and to follow out carefully. Conditions are always changing, and new ideas are being developed constantly. On large roads especially, it is important that the various shops be in close touch with one another. There are certain standard jobs done in every shop, the cost for which should be carefully watched and compared with the cost in the other shops of the system. If one shop is doing better than another, an analysis will show where the less efficient shop can be improved. It may be that the equipment is lacking, or that the men are not properly instructed. In the first case it might prove expedient to provide better equipment, and in the second case direct steps should be taken to properly educate the men. The best results will be obtained if the improvement work be under the direct charge of an efficient demonstrator. The exchange of ideas by correspondence is weak, in that the personal element is always lacking. A workman *shown* how to do a certain job is always more responsive than if he were *told* how to do it.

Reducing Weight in Car Design

A good many of the designs of steel freight equipment have been put into service so quickly, at a time of equipment shortage, that the designers did not have the opportunity to do their most effective work in the way of reducing the weight to a point as low as possible consistent with strength. There is so much variation in the weights of cars of the same capacity, but of different design, that it is impossible to avoid the conclusion that

much could be gained by a more effective distribution of the material in some of these designs. Of course, some of the older designs have shown up badly as regards strength, even though comparatively heavy, but it seems to us that this only strengthens the argument that the disposal of the metal was not the best possible. The steel car designer has accomplished a great deal in producing the equipment that is now in service, but we believe that there is still more to accomplish along much the same lines as those that have been adopted in recent years by locomotive designers, in tending toward refinement rather than merely toward size in producing capacity. What can be accomplished in the way of steel car design is evidenced by the 90-ton gondola cars, large numbers of which are in regular service on the Norfolk & Western. These cars weigh 59,000 lb. and it is worthy of special note that in the latest design this weight has been reduced practically 6,000 lb. and it is believed that the strength has not been impaired. When it is considered that these cars are mounted on six-wheel trucks we feel that there lies in this work of the Norfolk & Western mechanical department a subject for careful consideration by car designers in general.

Lost Motion in the Roundhouse

The apparent confusion with which the work of a large roundhouse is conducted is familiar to all who have occasion to visit engine terminals, especially if they attempt to locate any individual member of the force. The way in which the men are scattered throughout the house and the long trips necessary to secure material or tools are usually considered a necessary part of the conduct of the work. That much time can be lost where gangs are scattered throughout the house cannot be denied, the loss being accepted as necessary to secure the benefits of an organization of specialists, assigned to each class of work. At an engine terminal handling about 125 engines daily a plan has recently been worked out whereby the roundhouse is divided into sections of six stalls each. Each section is in charge of a gang leader whose gang is permanently organized to take care of all classes of work. No one is expected to or is permitted to leave the section of the roundhouse to which he is assigned, each gang being provided with its own set of tools. A handy man or laborer sufficiently familiar with the work to know material and tools is despatched to the tool room when special tools are required, and secures all material required from the store room. He also is expected to make the necessary trips to the blacksmith or machine shops. By having every mechanic assigned to work within a comparatively limited space the opportunity for lost motion should be materially reduced, and the ability to properly check up the force is greatly increased.

Developing the Apprentice

The practice recently adopted by the Atchison, Topeka & Santa Fe of sending some of its senior apprentices to the Baldwin Locomotive Works and to the Pullman Company, for experience, is deserving of more than passing notice. The Santa Fe is a road that thoroughly believes in developing its shop men from apprentices. It has the most extensive and well-developed apprenticeship system of any road in this country. It believes in developing the apprentice to the highest possible degree, and in order that the boys may learn still more than the Santa Fe can teach them, arrangements have been made with locomotive and car works, as indicated above, so that a few of the most apt and capable apprentices can enter these plants, work in their shops and study their organization and methods. Needless to say these boys, fresh from the hands of the apprentice instructor, will have their eyes open and their wits at work, noting how work is performed and how men are handled in shops other than their own. These boys are employed as sub-foremen, so that they have some responsibility and yet receive proper guidance. Undoubtedly, the time they spend in these temporary positions will be valuable to the apprentices themselves and to the Santa Fe when they return to that road. They will have passed their "cub" days as foremen; they will have been put through their "course of sprouts" among strangers and will come back to their road better able to govern the men who were once their bench mates. Their bashfulness and diffidence will have disappeared. They will have better control of the men, and in view of their experiences in these other plants the men will have greater respect for them.

Costs Needed in Reclamation Work

Reclaiming material from the scrap pile has become so common on the railways of this country that we believe it would be well to repeat a word or two of caution that we have uttered once or twice previously. Some of the so-called "reclamation work" is not reclamation. There are railway officers who are carrying out some branches of this work about which they are simply deluding themselves as regards savings. It is believed that this is mainly due to the failure to take into account the actual cost of everything concerned in the reclaiming. As a general consideration no branch of this work should be continued unless it is shown plainly that it is being conducted at a profit. It is quite within the bounds of possibility that material may bring a greater return to the company if sold as scrap than if it is put through the reclaiming plant and returned to service, and there is material being reclaimed that cannot be used again. Some roads have gone to the trouble to cut up old boilers with the oxy-acetylene torch in order to get higher scrap prices. We were told recently by the officers of a road that had tried this that it had been abandoned because after a thorough investigation it was found that it did not pay. We believe there are a great many roads which could conduct an investigation of this kind on some of their reclamation work to advantage to themselves, as there is no question that some of this work as it is being carried out is not profitable. We do not by any means intend to reflect on the value of reclamation work as a whole, nor upon the moral effect which it has on railway employees toward the prevention of waste, but we do feel that the test "Does it pay?" should be applied in every case.

The Expense of Poor Repair Facilities

"That engine has been in service 18 months; she is just falling to pieces, but I can't get her in the shop." It is nothing uncommon to hear a master mechanic make a statement of this character. There are large locomotives in great number that have been in service for long periods without any repairs other than those which could be given them at the engine terminal, itself inadequately manned and equipped. It is expensive to operate locomotives in this way; the cost of terminal repairs is increased, coal consumption is increased and there are more engine failures. The cause of this condition is the purchase in large numbers of locomotives of a size and type far beyond the capacity of the repair facilities on the road. Undoubtedly it is a difficult condition to control. In many instances, competing lines have large power and consequently high train load and if this competition is to be met, large power is essential. But poor judgment seems to be displayed at times in apportioning the money that is to be spent. A road that has small power, and shop and engine facilities in keeping with it, might better spend part of an appropriation for large locomotives on modern machinery and buildings than to put the entire amount into locomotives without any additional

facilities. With the same amount expended in both cases, we believe that the fewer number of locomotives properly maintained will take care of as much business as a larger number where the maintenance work is neglected. Locomotives have got to be repaired sooner or later and when the shops are too small or too poorly equipped to take care of the repairs at the time they are needed the large locomotives are invariably taken out of service and have to spend weeks and months awaiting their turn in the shop. Considering the cost of present day locomotives and the amount of money tied up when they are kept idle, their purchase without provision being made for effective maintenance would seem to be expensive economy.

Constructive Methods in Re-organization

A new officer is very seldom entirely satisfied with the organization of his predecessor. Very often he starts in almost immediately to make changes, some of which are ill-advised and result in trouble for him later. The changes made in instances of this kind too often give the impression that they are being made in order to give the appearance of making a showing. Of course, there are cases where an organization has become so demoralized that nothing but radical action will remedy matters, but we believe that in the majority of instances the desired results can be obtained without the wholesale discharging and transferring that seems to be so common. An example of what can be accomplished by constructive rather than destructive methods came to our notice recently. A young man was placed in charge of the repair work at a large terminal. The man who preceded him had held the position for many years and during the latter part of his foremanship had fallen into rather shiftless ways, with the result that those under him had begun to encroach on his authority and there was considerable disaffection. The newcomer was a man of ability and possessed of a nature which would not tolerate some of the practices which he found in effect. Several of the minor officers predicted his speedy downfall and one in particular announced his intention to "get" the new man. The foreman looked into matters very carefully and was strongly tempted to discharge this man and several others, but after thinking the matter over he decided against this. Instead he left the organization exactly as it was except for some minor changes and proceeded pleasantly but firmly to show all concerned that he was in charge, that he knew his business and intended to remain in charge. Within two months he had the terminal so improved that the changes were commented upon by the general officers of the road and the man who at the start was apparently his worst enemy was now his stanchest supporter. We cite this example merely to show that fire-eating methods are not always necessary in cases of this kind, and if they are not necessary they are certainly not desirable.

Periodical Appropriations for Material

Most railways employ a system of periodical appropriations for labor, and officers of the mechanical department are generally familiar with the way men are laid off and working hours are cut at the end of the month to insure the expenditures falling within the appropriated amount. The material used in the conduct of railway operations is expensive and is rapidly growing more so. It costs a railway a great deal of money to have unused material lying around the various shops and enginehouses. There are always more or less vigorous steps taken to prevent the waste of material, but they are often inconsistent, and in spite of them a great deal is wasted and a great deal is charged out and then lies unused. If periodical appropriations were extended to cover material as well as labor we believe that it would not only result in a marked reduction in the amount of material carried in this way, but would also greatly facilitate the work of maintenance of equipment by increasing the flexibility of appropriations, because a master mechanic or foreman could then so adjust his work in many instances as to save on expenditures for material and use the saving as an expenditure for labor. Of course, the supply department would have to co-operate to the greatest degree with the mechanical department, and the latter would have to be kept advised at all times of their total expenditure to date. A system of this kind is being employed on the Seaboard Air Line and its success is attested by officers of the mechanical department. By a very slight expenditure, the supply department keeps such a record of material used that the mechanical department can find out at any time what the expenditure is and a periodical report of material expenditures is furnished to the mechanical department and is in the hands of the officer concerned within two days of the close of the period. It will be recognized at once that the success of any system of this kind depends largely on the supply department keeping its records always up-to-date, as if the information regarding the material used is to be of any use it must be available when it is wanted. This practice has apparently been worked out with such simplicity and at the same time so effectively on the Seaboard that it seems strange that it has not been employed elsewhere.

NEW BOOKS

Proceedings of the Traveling Engineers' Association.—Bound in leather. 329 pages, 5½ in. by 8½ in. Published by the association, W. O. Thompson, secretary, New York Central Railroad, Cleveland, Ohio.

This is the proceedings of the twenty-third annual convention of the association held in Chicago, September, 1915. The subjects covered include: The effect of lubricating and mechanical firing on locomotive operating costs; recommended practice for employing and training new firemen; smoke prevention; advantages of superheaters, brick arches, etc.; improving the handling of air brakes; the electro-pneumatic brake; valve gear and its relation to fuel economy and operating costs; scientific train loading.

Locomotive Engine Running and Management.—By Angus Sinclair. Bound in cloth. 428 pages, 5 in. by 7½ in. Illustrated. Published by John Wiley & Sons, Inc., New York. Price $2.

This is the twenty-third edition of a book which has been most favorably known in railroad circles since 1885. There are many successful railroad men who obtained their first knowledge of the locomotive and its management from this book and it is a most valuable work for anyone concerned in the operation of locomotives. In this edition the book has been thoroughly revised and brought up to date and the author states that it is now practically a new book. The changes in air brake apparatus have been covered and a section on electric locomotives has been added.

The Mechanical Engineers' Pocket-Book.—By William Kent, M.E., Sc.D. Bound in leather, 1477 pages, 4 in. by 6¾ in. Illustrated and indexed. Ninth edition, revised and enlarged. Published by John Wiley & Sons, Inc., New York. Price $5.

This reference book is so well and favorably known among engineers that it scarcely needs any special notice. In this, the ninth edition, the work has been thoroughly revised with the assistance of Robert Thurston Kent, M. E., consulting engineer. Extensive revisions have been made in the subjects of materials, mechanics, fans and blowers, heating and ventilation, fuel, steam boilers and engines and steam turbines. The new matter includes much data on such subjects as planing, milling, drilling and grinding and the chapter on machine shop practice has been rewritten and doubled in size. The matter pertaining to electrical engineering has been completely rewritten and brought into agreement with present practice, and many new tables have been added.

COMMUNICATIONS

THE MECHANICAL DEPARTMENT CLERK

CHICAGO, Ill.

TO THE EDITOR:

I am a mechanical department clerk—a chief clerk, to be exact—and am therefore one of the "crowd of competent and incompetent men—usually in blind-alley jobs, with no training and no outlook."*

The mechanical department clerk is, in a sense, in a blind alley. He cannot succeed to the position of general foreman, master mechanic or superintendent of motive power. You ask why any of us start to work in this capacity in a department where there is so little opportunity ahead, and why we stay in it. For numerous reasons. In the first place, we may have undertaken the work at an age when we could not understand the real state of affairs and our parents were unable to advise us correctly. As one of the correspondents in the Railway Age Gazette has suggested, "The average young fellow when he leaves school wants to get into an office because he can be dressed up."

Why do we stick? Because by the time we can think for ourselves we are probably getting $65 or $75 a month, have a "best girl" to entertain, and do not have the courage or inclination to start in another line of business at lower wages.

I worked my way through various positions to that of chief clerk in the office of the leading master mechanic on the system and am receiving the highest salary paid to a master mechanic's chief clerk. If I resign this position, where shall I go to find a better one? Shall I aspire to be chief clerk to the superintendent of motive power? If so, how about the assistant chief clerk and others in the superintendent of motive power's office who are earnestly striving for advancement? If I should be successful in obtaining that position, where shall I turn next? The transportation department appears to be the most logical course, since clerks in that department are sometimes promoted to the position of trainmaster. It is necessary, however, if I wish to enter that department, to work up from the bottom. This I cannot do because I have a family to support.

If there is any department on a railroad where the efforts of a clerk are less appreciated than in the mechanical department, I should like to know it. The men holding official positions in this department usually advance from the shops and are purely and simply practical men. As a rule they fitted themselves for their positions not by technical training, but by having made good in shop work. They must be supported by an efficient office force.

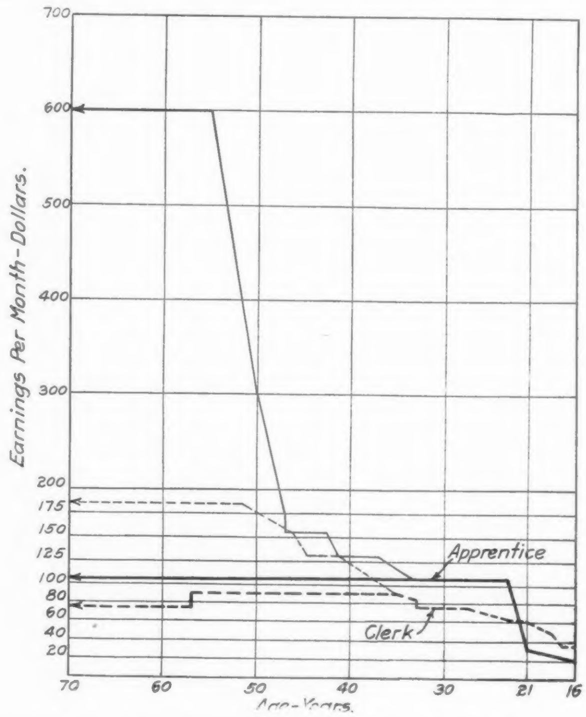
Listen to the remark made by a "boss" who took a lively interest in the welfare of one of the office boys and was advising him to go into the shops and learn a trade. He said, "Young man, do you want to stay in an office all of your life, or would you like to get into the shops and make something of yourself?" This is typical of the men above us in the mechanical department.

Accompanying this letter is a chart which illustrates the comparative progress of a mechanical department clerk and a machinist apprentice. The heavy dotted line shows the progress of the average railroad clerk; the lighter dotted line shows the progress of a fortunate or exceptional clerk. The heavy continuous line shows the progress made by the average apprentice, and the lighter one that of an exceptional or more fortunate apprentice.

The average clerk is, in general, and must be, superior to the average apprentice in knowledge and mental training; but what is the reward? (Study the chart. It was not made up after a moment's thought, but reflects true conditions.) The apprentice, after serving four years, automatically becomes a journeyman machinist and is entitled to the standard wage. Ninety-eight per cent. of the graduate apprentices qualify. They join a union, which insures them a living wage and recourse in case of sharp practice. With them it is a case of "if you don't like your job, quit," and they can always command a salary sufficient to meet living expenses. The clerk advances slowly as vacancies occur, but does not *command* a salary and enjoys no feeling of independence.

Suppose the clerk should finally reach the position of chief clerk. The master mechanic leaves and the position is filled by the transfer of another master mechanic from a smaller point. The new incumbent follows the line of least resistance. His former chief clerk satisfied him and was familiar with his personality, requirements, etc. It is too much of an effort to break in the present chief clerk to meet his wishes and he finds a reason to let him go, or demote him. And what recourse has the chief clerk or any other clerk?

In the Railway Age Gazette of September 3, 1915, Homer Pigeon, in an article entitled "The Unnoticed Unorganized Employee," had the following to say concerning train despatchers (the statement is equally true of clerks): "There



Comparison of the Earnings of the Clerk and the Apprentice

are many other ways in which railway companies can serve their own interests by devoting a little thought to the welfare of those employees who do not belong to a fraternal order. I hope to live long enough to see some of them put into operation. If I do not, I know that I shall live—if the life insurance companies guess correctly as to my prospects—to see many more men driven into organization in self defense."

R. V. Cooke takes equally as strong a position on the other side of the question in a letter in the Railway Age Gazette of December 24, 1915: "Again, organization of all branches of clerks would not be fair to the companies that employ us. We, through the very nature of our positions, handle some of the most confidential affairs of the company, and, as we are but human, who among us could keep from using this information to our advantage if we owed allegiance to an outside organization? Loyalty to the company is nothing more than is due. I believe that a railroad clerk must not affiliate with a labor organization; but it looks as though the danger suggested by Homer Pigeon will develop unless something is done to better the conditions of the average clerk.

A. C. CLERK.

*This quotation is taken from an address by George M. Basford before the Burlington Association of Operating Officers, the exact quotation reading, "Clerks are a crowd of competent and incompetent men—usually in blind-alley jobs, with no training and no outlook." The address in full appeared in the Railway Age Gazette of July 23, 1915, page 150.

Which is Most Worth While?

BY HARVEY DE WITT WOLCOMB

In these days, when the study of reclaiming scrap for nearly all classes of material used by the railroads has reached the point where phenomenal records are being made, it is surprising that more attention is not given to better utilization of the older employees.

At first thought, it may appear inhuman to ask and expect any regular assigned tasks from an old employee that has worked hard all his life in the company's service; yet we only have to follow up the history of some one of the many engineers who are taken out of active service at the age of 70 years, and who are apparently in the best of good health, and see how quickly they either break down or die after being placed on the pension list. Or take an active shop man and see how quickly he ages after he is taken out of the shop and is required to stay at home with nothing on his mind to think about. There is really a humane side to the question of providing some agreeable occupation for the old employee, and in the meantime the company can receive some small returns if the problem is given proper consideration.

OLDER MEN MORE ACCURATE

There is a certain fascination in working for a railroad that holds a workman, even if higher wages can be secured from neighboring concerns, and one of the strongest factors of this fascination is the thought that when he has grown old and feeble he will be given something to do that will keep his name on the pay roll. For a man who has had active service to be given some light task for which there is no responsibility or action required, is both harmful to the man and to the company. Even if the man is old and feeble, he still retains his keen mental abilities and is well able to see and do certain things better than some untrained young man just starting out in life. A typical example of this kind was forcefully brought out in looking over a large office of clerks, where a reorganization had just been made and new clerks employed in order to increase the efficiency. The chief clerk was asked if the results were satisfactory. His reply was that the new clerks were quick, but if he desired some specially accurate report, he usually gave it to one of the older clerks who had been in the office over 30 years. While the older clerk could not compete with the speed of the younger men, he still held a very important place in the office because of his accuracy.

It is comparatively easy to find some position, such as gate tender or crossing watchman, for the old employee in the transportation department, or the employee that has been crippled through some unfortunate accident, but in the mechanical department it is quite an undertaking to place the old employee so that he will be contented and show some returns. An old employee that has shown much skill and good judgment throughout his long term of service may be in good condition to inspect or instruct along the lines of his trade, although he is not strong enough to handle the heavy work that is now required on our large locomotives. As a suggestion, why not appoint them as inspectors about the shop? They have learned the folly of jumping at conclusions, and by working with the young mechanics will be in a position to offer many good ideas to improve the shop output.

PRACTICAL SUGGESTIONS

Where is it possible to secure a better safety inspector than to select some old employee that has seen the result of carelessness and haste? Perhaps he will be recognized as an "old granny," but is it not better to have an ounce of prevention than a pound of cure? It is not necessary to accept everything he reports, but if his suggestions are passed on by the regular shop safety committees, it will be found that many of his ideas are good. Much time is lost in the shops because of tools and shop appliances being misplaced and any old mechanic will more than earn his salary by looking after such tools. Shop jacks are seldom oiled, with the result that they very often get out of repair. Pinch bars are usually dull when required for a hurry-up job; both of these items can be looked after by some worn out mechanic that is unable to handle regular shop work, but is still able to get about the shop. After a serious accident has happened because of a sledge handle breaking or the head flying off the handle, it has been found a paying investment to have such tools looked after by an old workman who is familiar with the small defects that often result in bad accidents. In the fall, when it begins to get dark during the regular shop hours and the workmen require torches, it is quite an economical practice to have an old mechanic gather up all the torches about the shop and fit them up ready for immediate use so that it will not be necessary for a high-priced mechanic to waste time in doing so.

In a small shop where a crippled tinsmith was employed it was found that there was not enough tin work to keep him busy. As he was both a good workman and anxious to keep busy, he suggested that all the old lanterns on the division

be sent in so that he could overhaul them. After it was tried out for a short time, it was found to be such a good idea that all the lanterns on the entire railroad were shipped to that one point for repairs, and additional men were employed to keep the repairs up.

On another road where it had been the practice for some time to sell wagon loads of scrap wood removed from the freight cars at fifty cents a load, a worn out or "scrap" carpenter was given charge of the scrap woodpile. This man was badly crippled with rheumatism and hardly able to write, so it was impossible for him to keep an elaborate set of records, but he had proved his honesty in his long term of service and he was therefore assigned to watch the woodpile. He soon proved that while he could not do manual labor, he still had his wits about him and that with a very little sorting there was much second wood that could be used over again to make box car doors and other parts of wooden cars. He also put the scrap pile on a commercial basis so that it paid better than when there was no one directly interested in it.

These two men showed to their employers that although they were classed as old worn out material, commonly called "scrap," they were still able to be "reclaimed" and be put to some useful purpose, even if not at the same tasks they had worked on all their lives. If these men were successful, is it not possible that there are many more in the same position on other roads?

IN THE CAR REPAIR YARD

In a large car repair yard an old employee was placed on the retired list and was soon forgotten. He had been used to hard work all his life and the awful monotony of hanging around soon made him sick. He was big enough to realize that if he gave up and went home, he would never get back again so he appointed himself the task of picking up all the discarded nuts and washers around the car repair yard. He soon had such a busy job that he forgot his troubles and at the end of six months it was found that he had actually saved more material than his wages came to. He not only saved material but he had it so placed that the workmen did not lose time getting it, which was another big item of saving.

Another way to take care of the worn out employees is to appoint them fire inspectors or building watchmen, for as a rule the old men are punctual and trustworthy and make the best kind of inspectors, for they are on the job all the time. As a man grows older in the service, he thinks less of his own personal pleasures and more of his employer's interests. This is proven during vacation time for we find that where some young man will plan an elaborate vacation, the old "timer" will not take any time off. This thought is not presented to imply that vacations are not necessary, for they are a positive requirement, but often a foreman who has been on the job for several years will never take the regular and necessary rest which the younger man calls his vacation.

SEVENTY YEARS YOUNG

No matter how small a shop is, there is some place where the old, faithful employee can be taken care of both to his and the company's advantage. All old men are not scrap, which is to be thrown away as useless. We are all familiar with a certain important railroad president who was "70 years young" at his seventieth birthday. This wonderful man at that age ranked as one of the most active heads of any railroad in the United States. Just imagine the loss to his railroad if he had been relegated to the human scrap pile at the time when his long years of training and experience fitted him to give the very best of service.

One of the most important things in the life of a railroad man is to be able to exercise discretion; very often we find a young man is not given a responsible position because he has not yet reached the age of proper discretion, or had the necessary training to learn its very important bearing on successful railroading; yet right on top of this we find that some other employee is considered too old and is appointed a candidate for the scrap pile.

STOPPING LEAKS

In a large plant having an extensive heating system, one of the plumbers was too old to do the regular work so the foreman gave him the job of looking after all the small steam leaks about the plant. He was told that "a stitch in time saved nine" and to stop a small steam leak would very often prevent a larger one. After the old man had been on the job for a short time, the heavy steam heat repair jobs began to be less frequent. Still another old employee was given the task of looking after all the water leaks. He had to inspect all pipes, faucets and other places where water was used; he soon showed that his appointment was profitable to his company.

In another large industrial plant, the original founder has been displaced by his two sons, but he refuses to be turned over to the scrap pile and very frequently goes into the shop and works with the mechanics. By doing this, he feels that he is still in trim to do a day's work and the men about the plant, realizing and appreciating his wonderful vitality, are all the more loyal to the company. No job in the shop is too dirty or too hard for the old man to tackle and his example is followed by every employee.

It is not often that we find an employee who is looking forward to that day when he will be told to remain at home with nothing to do but draw his pension. It is nice to think of the pleasure of having nothing to do but the old employee will find himself in the same position as the old discarded fire horse that was used on a milk route. While standing one day near a fire station, an alarm came in and the old horse responded to his early training by making a record run. It is the old employees who will tell you that the best music they know of is to hear the old shop whistle call the men to work and to realize that they are able to respond.

THE HARE AND THE TURTLE

Local conditions vary so much that it is impossible to work out any set rule to govern the proper placing of the old employee, but if a careful study is made of the shop conditions, some place will be found where the old men can be used to good advantage. The excuse of the old man being too slow for the present day requirements can be answered by quoting the result of the race between the hare and the turtle, for while it must be admitted that the old man is slower, the fact remains that he will get results. We will always have the old fellows around the shop and it is up to the successful manager to provide some position not only to keep them busy, but to keep them satisfied so that they will not have the impression that they are discarded pieces of junk and only fit for the scrap pile. If the success of reclaiming scrap material is established then the success of reclaiming the old employee is assured and the company will receive as much benefit from one as the other.

There is no limit to what can be done for the old employee for which the company will receive some returns. In a certain large shop, an old employee complained of the bad lighting system and offered the excuse that he was not as young as he used to be and that his eyesight was failing. Investigation developed the fact that the lighting system was very bad not only for the old man but for the young mechanics; by making certain changes the efficiency of all the workmen was increased to a marked degree. In another shop, an old employee reported that he was unable to handle the heavy work he had been doing for several years as there were no cranes or other conveniences to lift the heavy castings. An investigation proved that the shop was so far behind the times on shop conveniences that it was in the antiquated

class and the old employee was assigned to select and locate any apparatus that would facilitate the work. He soon showed that where formerly two and three men were required on a job, the same work could be handled more quickly and economically by one man with the use of mechanical apparatus for doing the "strong back" work than when it was handled by several workmen. The number of accidents was reduced and the shop output increased, all because an old worn out employee was "reclaimed."

It is impossible to give all the examples of what has been accomplished by reclaiming the worn out employee, but as every shop has the necessary material to work on, it is suggested that every one get busy and see what can be done at their plants.

Just remember that the proper definition of the word reclaim does not mean to reform or make like new, but should be given the broader sense of "to be used to take the place successfully of something else."

DIAMETER OF DRIVING AXLE JOURNALS

BY L. R. POMEROY

The usual method of calculating the combined or resultant lever arm for bending and twisting is as follows: Let *A B* equal the crank radius and lever arm for twisting, and *B C* the distance, in cross section, from the center of the cylinder to the center of the frame. Combining, the resultant or equivalent lever arm for bending will be:

$$L_r = \frac{BC + \sqrt{(BC)^2 + (AB)^2}}{2}$$

The writer has adopted a simplification of this, namely:

$$L_r = \sqrt{(BC)^2 + (AB)^2}$$

This method provides a resultant lever arm about 8 per cent greater than that obtained by the former method, which at least is an error toward greater strength rather than a reduction. To demonstrate just how axles designed by this latter method compare with existing practice, the accompanying table is submitted:

With a view to still further simplifying the method of finding the proper diameter the diagram in Fig. 1 is offered.

The method of reading the diagram is shown by the dotted line given as an example. Starting from boiler pressure, follow downward to the diagonal for Cylinder diameter (at which point the piston thrust can be directly read on the right hand margin). From this point read horizontally to the left, to the diagonal for the resultant lever arm L_r, and thence upward to the top, where the diameter is read. The resultant L_r is found by means of the small diagram.

The diagram in Fig. 2 is arranged to find the fiber stress from any given axle diameter. The method is practically the same as that employed for Fig. 1. For example, beginning at boiler pressure, follow down to the diagonal for cylinder diameter, thence to the left to the diagonal for axle diameter, thence upwards or downwards, as the case may be, to the diagonal for L_r, and from L_r to the left to the margin, where the fiber stress is read; L_r is found as in Fig. 1 from the small sketch shown on the diagram.*

The diagram shown in Fig. 3 is to determine the diameters of crosshead and crankpins (other than the main crankpin), on the basis of allowable piston thrust against the projected area (diameter multiplied by the length) of the pins. This diagram is read in the manner prescribed for those in Figs. 1 and 2;) that is, from boiler pressure down to cylinder diameters, thence to the left to either one of the two diagonals for crosshead or crank pins and upward to the top scales for projected area. The allowable piston thrust for crosshead pins is given as 4,600 and 4,800 lbs., and for crank pins 1,600 and 1,700 lbs.

There are several methods of calculating the diameter of main axles which are more complicated and involved than the method described. In each case a lower fiber stress is used in connection with the static load on the axle and the support of adjacent side rods, in connection with

Name of road	Type	Cylinder diameter and stroke	Boiler press., lb. per sq. in.	Crank radius A B; lever arm for torsion. Inches	Distance from center line through cylinder to center line through frame, B C; lever arm for bending. Inches	Combined or resultant lever arm A C $\sqrt{AB^2+BC^2}$ Inches	Diameter of main axle by formula; f. s. 21,000 lb. basis of cyl. diam. + ½ in. for wear. Inches	Actual diameter in use on the locomotive. Inches
Ill. Cen.	2-8-2	27 × 30	175	15	23.5	27.8	10.95	11.00
C. & O.	2-8-2	29 × 28	170	14	24.5	28.2	11.50	11.50
C. & O.	4-8-2	29 × 28	180	14	24.5	28.2	11.70	11.50
C. & O.	4-6-2	27 × 28	185	14	25.0	28.7	11.40	11.50
Mo. Pac.	2-8-2	27 × 30	170	15	23.5	27.8	11.00	11.00
Erie	2-8-2	28 × 32	170	16	24.5	29.2	11.60	11.00
Erie	2-10-2	31 × 32	200	16	26.5	30.9	13.15	13.00
C. & N. W.	2-8-0	25 × 32	170	16	23.5	28.4	10.58	10.50
C. & N. W.	4-6-2	23 × 28	190	14	23.0	26.9	10.20	10.50
A., T. & S. F.	4-6-2	26 × 26	200	13	24.5	27.7	11.26	11.00
C. P. R.	2-8-2	23½ × 32	180	16	24.0	28.8	10.30	10.00
C. P. R.	4-8-2	23½ × 32	200	16	22.0	27.2	10.48	11.00
P. R. R.	4-4-2	23 × 26	205	13	20.75	24.5	10.10	* 9.50
P. R. R.	2-8-2	27 × 30	205	15	24.0	28.3	11.60	*11.00
L. V.	4-6-2	25 × 28	215	14	23.5	27.8	11.20	10.00
R., F. & P.	4-6-2	26 × 28	200	14	24.5	28.2	11.44	11.50
C., B. & Q.	2-10-2	30 × 32	175	16	24.0	28.8	12.08	12.00
B. & O.	2-8-2	24 × 32	200	16	24.5	29.3	10.90	11.00
C., M. & St. P.	2-8-0	23 × 30	200	15	22.5	27.0	10.40	10.50
C., M. & St. P.	4-6-2	23 × 28	200	14	23.0	26.9	10.30	10.00
N. Y. C.	4-6-2	23½ × 26	200	13	23.0	26.4	10.60	10.50
N. Y. C.	4-6-2	24 × 26	200	13	23.0	26.4	10.60	10.50
N. Y. C.	4-6-2	26 × 26	180	13	23.0	26.4	10.70	10.50
N. Y. C.	2-8-2	25 × 32	180	16	23.0	28.0	10.70	10.50
A. L. Co., 50,000	4-6-2	27 × 28	185	14	23.0	26.9	11.20	11.00
B. & O.	2-10-2	30 × 32	200	16	26.0	30.3	12.70	13.00
D., L. & W.	4-6-2	25 × 28	200	14	24.0	27.7	11.05	11.00
G. N.	4-8-2	28 × 32	180	16	23.0	28 0	11.48	11.00
P. & R.	2-8-2	24 × 32	225	16	24.0	28.8	11.10	11.00
L. S.	2-8-2	27 × 30	190	15	24.5	28.7	11.60	†11.50
C., R. I. & P.	2-8-2	28 × 30	180	15	24.5	28.7	10.32	11.50
W. & L. E.	2-8-0	26 × 30	185	15	24.0	28.2	11.14	11.00

* Heat treated axle. † Vanadium steel axle.

*The diagrams are based on the following formulas: For Fig. 1—

$$\text{Diameter of axle, } d = \sqrt[3]{\frac{(\text{dia. Cyl.} + \tfrac{1}{2}\text{ in.})^2 \times .7854 \times \text{Boiler Pressure} \times L_r}{21{,}000 \times 0.0982}}$$

For Fig. 2—

$$\text{Fiber stress} = \frac{(\text{dia. Cyl.} + \tfrac{1}{2}\text{ in.})^2 \times .7854 \times \text{Boiler Pressure} \times L_r}{d^3 \times 0.0982}$$

assuming a fiber stress of 21,000 lb. and ignoring the dead load or support of adjacent side rods.

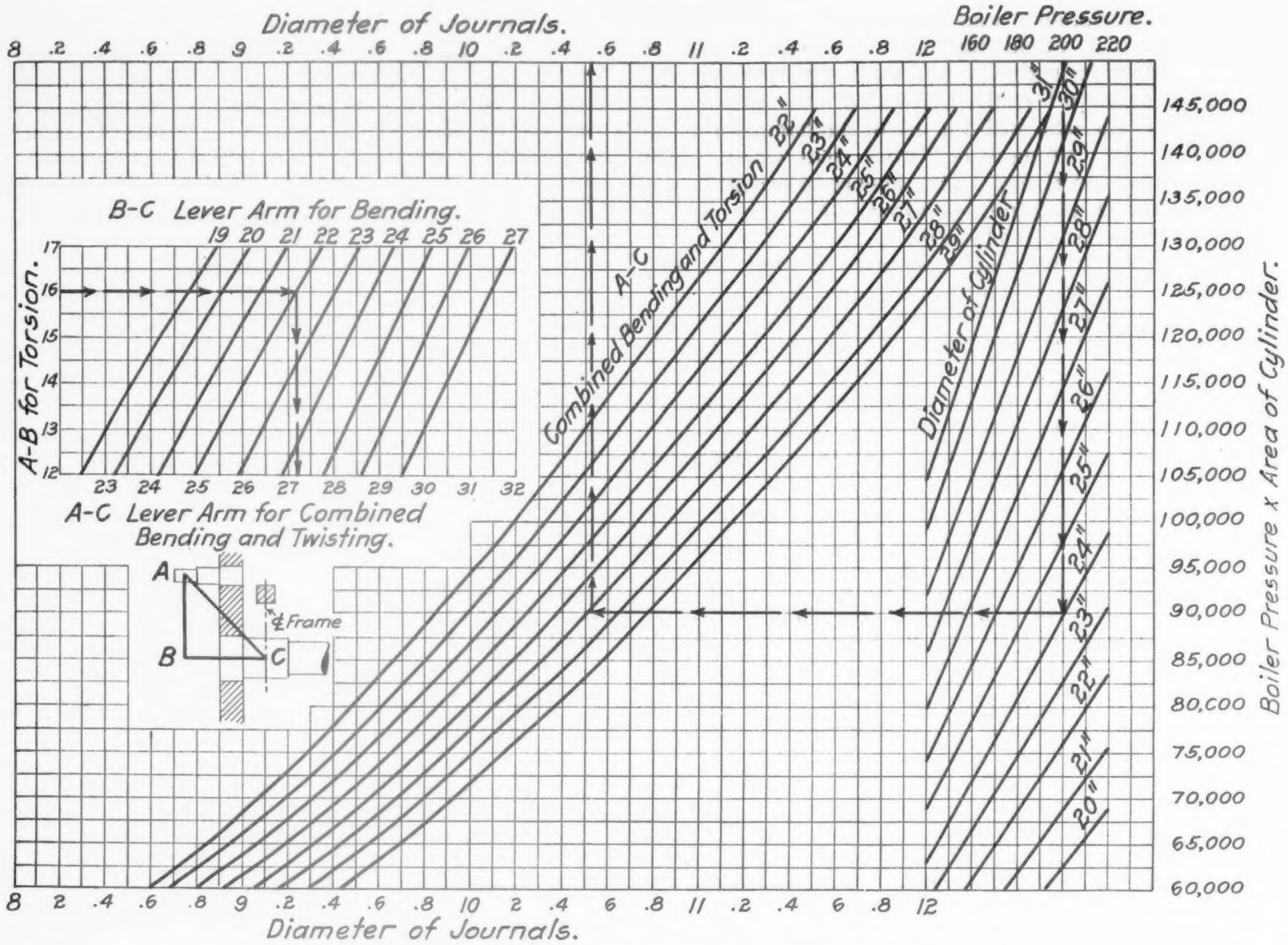


Fig. 1—Diagram for Determining the Diameter of Driving Axle Journals

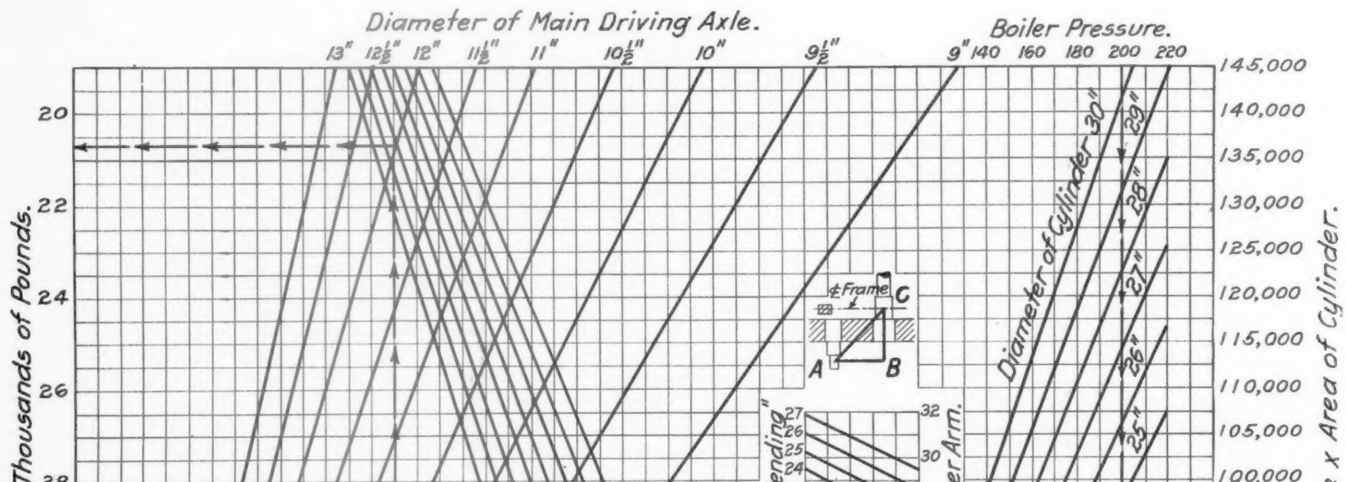


Fig. 2—Diagram for Determining the Fiber Stress for Any Given Axle Diameter

combining the torsion and binding. As all of these methods provide in the end for practically the same size of axle as that obtained by the writer's method, no hesitation is felt in offering the shorter way, especially as the table, showing current practice checks so closely. The methods referred to are as follows:

I. Method employed by G. L. Fowler and C. J. Mellin in Machinery's Hand Book, No. 29.

$$\text{Fiber stress} = \sqrt{\left(\frac{Pl}{2}\right)^2 + (Wb)^2 + \left(\frac{\frac{0.3 \times W \times D}{s} \times r}{2}\right)^2} \div (\text{dia. axle})^3 \times 0.0982$$

Where P = (dia. Cyl.)^2 × 0.7854 × Boiler Pressure.
l = Distance from center line of main rod to center line through frame.
b = Distance from center line of rail head to center line through frame.
W = Weight on axle = Weight on pair of main wheels and axle, less weight of wheels and axles.
D = Diameter of drivers.
s = Stroke in inches.
r = Radius of crank.

$\frac{Pl}{2} + (W \times b)^2$ = Bending moment due to piston thrust plus dead weight.

$\left(\frac{\frac{0.3 \times W \times D}{s} \times r}{2}\right)^2$ = Bending moment due to torsion.

It is stated that the torsional stress is taken as the weight necessary to slip the drivers, with the claim that anything above this is transferred through the side rods to the adjacent drivers, as one crank is in a favorable position to slip the wheels when the other is on the dead center, thus taking up all the slack in the rods and relieving the axle from the full bending force of the piston; therefore half the piston thrust is used. Also, one-half the piston thrust is taken for both bending and torsion as noted in the formulas.

For example, let us consider a 2-8-0 type locomotive with P = 70,000 lb., l = 22 in., W = 40,000 lb. (less wheels and axles) = 32,000 lbs., b = 10 in., crank radius = 13 in., stroke = 26 in., D = 57 in.

$$\text{Fiber stress} = \sqrt{\left(\frac{70,000 \times 22}{2}\right)^2 + (32,000 \times 10)^2 + \left(\frac{\frac{0.3 \times 40,000 \times 57}{26} \times 13}{2}\right)^2}$$

= 819,500 = moment in inch-pounds.

Then the f, s, solving for an 8-in. axle $= \frac{819,550}{d^3 \times 0.0982} = \frac{819,550}{50.28} = 16,300$ lb.

Or with a fiber stress of 16,000 lb. the limit used in the text, the diameter equals

$$\sqrt[3]{\frac{819,550}{16,000 \times 0.0982}} = 8.035 \text{ in.}$$

To this is added an allowance for wear for cylinder and axle and the axle diameter is then 9 in. at the journal.

II. G. R. Henderson's method:

This is on the basis of combined bending due to piston thrust and dead weight. Torsion is not included as it is assumed that the piston is at the end of the stroke and the crank is on the center, under which conditions no torsion is present. Torsion is considered at a maximum when the pin is at the top or bottom quarters.

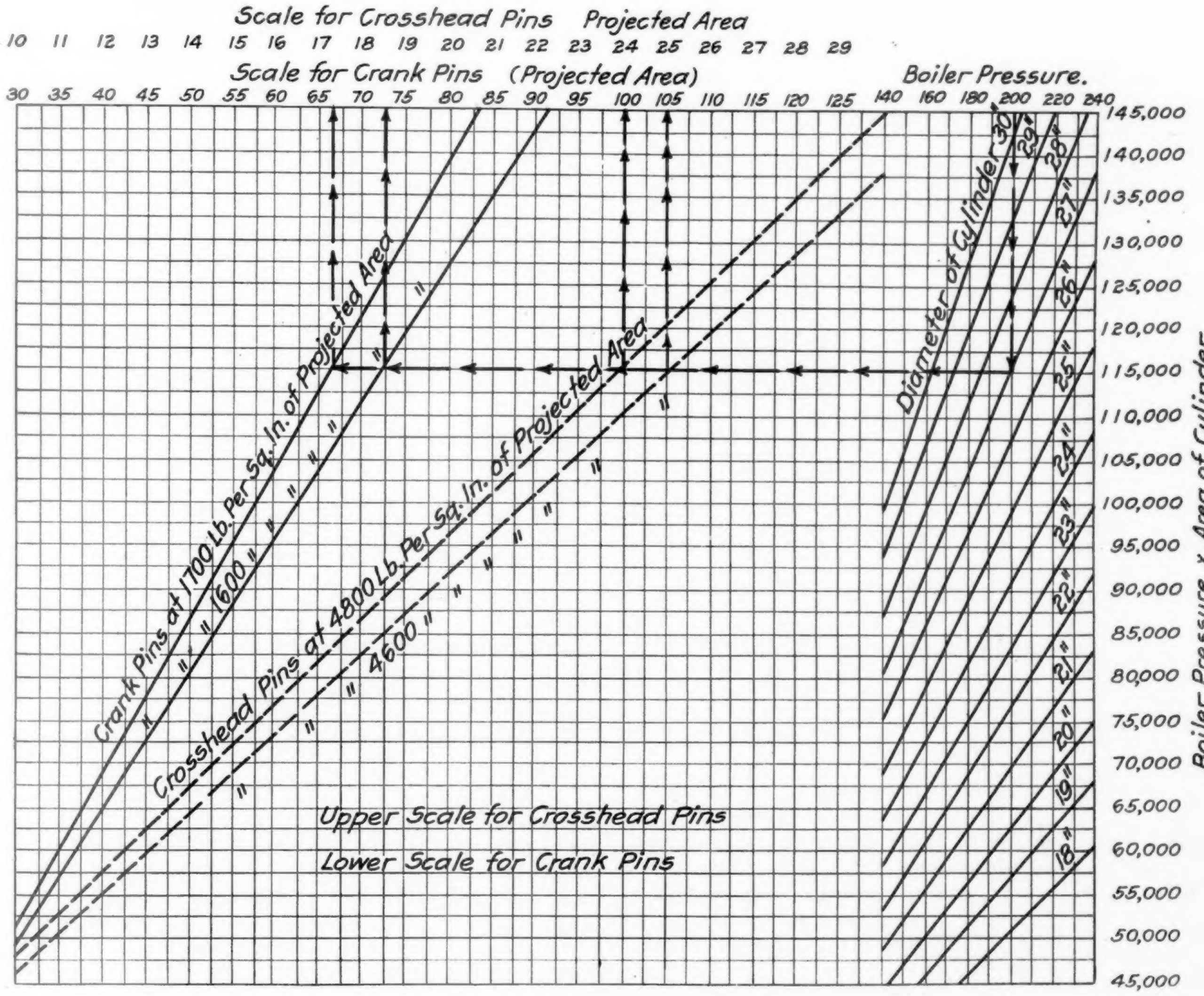


Fig. 3—Diagram to Determine the Diameters of Crosshead Pins and Crank Pins

Using the same symbols, quantities, and dimensions as above the fiber stress for a 9-in. axle becomes

$$\frac{\sqrt{(Pl)^2 + (\frac{1}{2}\,W \times b)}}{71.6} = \frac{\sqrt{(70,000 \times 22)^2 + 200,000^2}}{71.6} = 21,680 \text{ lb.}$$

At the top quarter we still have the vertical bending moment, ½ Wxb, as at the end of the stroke, but the horizontal force is dependent on the shipping of the wheels. The force P., causes a horizontal bending moment Pxl., but the resistance to slipping of the near wheel also causes a horizontal bending moment in the same direction, whose value is $\frac{Wxb}{2x3.5}$ and the horizontal bending moment becomes;—

$$W \times \frac{(D \times l) + (b \times r)}{7 \times r}$$

The twisting or torsion moment equals

$$\frac{W \times D}{14}$$

Combining the bending moments we have

$$\sqrt{(\tfrac{1}{2}\,W \times b)^2 + \left[W \times \frac{(D \times l) + (b \times r)}{7\,r}\right]^2} = \sqrt{\left(\frac{40,000 \times 10}{2}\right)^2 + \left(40,000\,\frac{57 \times 22 + 10 \times 13}{7 \times 13}\right)^2} = \sqrt{200,000^2 + 608,000^2} = 639,700 = M_b \text{ or bending moment.}$$

$$\frac{W \times D}{14} = \frac{40,000 \times 57}{14} = 163,000 = M_t \text{ or twisting moment.}$$

According to Rankin the equivalent bending moment when M_b is greater than M_t =

$$M_{bt} = \tfrac{1}{2}\,M_b + \sqrt{M_b^2 + M_t^2} \text{ or } \frac{639,700}{2} + \sqrt{639,700^2 + 163,000^2} =$$

979,050 M_{bt}; or the combined bending and twisting moment in inch-pounds. The fiber stress becomes

$$\frac{979,050}{d^3 \times 0.0982} = 13,700 \text{ lb.: or for a } 9\tfrac{1}{2}\text{-in. axle } \frac{979.050}{84.19} = 11,500 \text{ lb.}$$

III. F. J. Cole's method given in the *American Engineer,* April 1898, page 124, using the same symbols and figures as for previous illustrations:

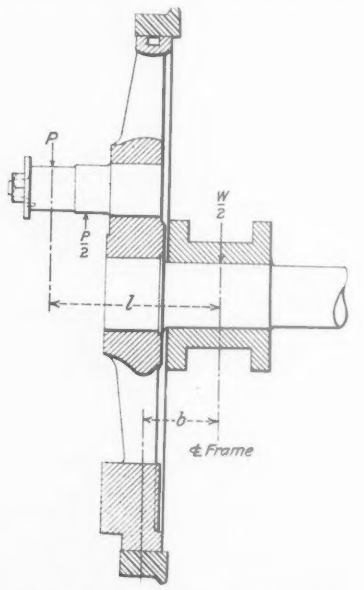


Diagram for Use with Method 1

1. Fiber stress from bending moment due to piston thrust,—

$$f.\ s. = \frac{P \times l}{2 \times R} = \frac{70,000 \times 22}{2 \times 71.6} = 10,800 \text{ lb.}$$
(71.6 = R. for 9-in. axle)

2. Fiber stress from bending moment due to dead load,—

$$f.\ s. = \frac{W \times b}{2 \times R} = \frac{32,000 \times 10}{2 \times 71.6} = 2,240 \text{ lb.}$$

Combining to arrive at the resultant f. s.,—

$$\sqrt{10,800^2 + 2,240^2} = 11,020 \text{ lb.}$$

For the torsional stress the force of the piston is divided equally between the driving axles. In the illustration used there are four driving axles. We then have

$$\frac{\frac{1}{2}\,P \times r}{4 \times R} = \frac{70,000 \times 13}{8 \times 71.6} = 1,580 \text{ lb.}$$

Mr. Cole assumes that one-half of this quantity is the maximum torsional stress likely to occur at any one time. Then we have

$$1,580 \div 2 = 790 \text{ lb.}$$

The stress due to centrifugal force =

$$\frac{W \times V^2}{8 \times \text{radius of curve}} = \frac{40,000 \times 5,373}{32.2 \times 955} = 7,000 \text{ lb.}$$

The lever arm = ½ the diameter of the drivers = 28½ in. and the fiber stress due to centrifugal force =

$$\frac{7,000 \times 28.5}{71.6} = 2,800 \text{ lb.}$$

This is based on a 6 deg. curve, = 955 ft. radius, a speed of 50 m. p. h., of 73 ft. per sec. ($73^2 = 5373$).

The flange pressure was assumed as not to exceed one-half of the torsional force, the remainder being assumed to be absorbed by the outer rail, or equal to 790 lbs. The equivalent bending moment as above equals 11,020 lb. Combining this with the torsional stress the final resultant

$$Y = \frac{11,020}{2} + \sqrt{\left(\frac{11,020}{4}\right)^2 + 790^2} = 11,407 \text{ lb.}$$

or say a 9-in. axle.

Mr. Cole places the f. s. limit for fiber stress as follows:

2-8-0 type	8,500 lb.
4-6-0 and 2-6-0 types	9,500 lb.
4-4-0 type	13,000 lb.

If a 9½-in. axle is chosen the f. s. would be

$$\frac{70,000 \times 22}{2 \times 84.20} = 9,200 \text{ lb.}$$

$$B_m \text{ due to piston thrust} = \frac{W \times b}{2 \times 84.20} = \frac{32,000 \times 10}{2 \times 84.20} = 1,900 \text{ lb.}$$

$$B_m \text{ due to dead load, combining,} = \sqrt{9,200^2 + 1,900^2} = 9,397 \text{ lb.}$$

$$\text{Torsion} = \frac{\frac{1}{2}\,P \times l}{4 \times R} = \frac{70,000 \times 13}{8 \times 84.20} = 1,350 \text{ lb.}$$

Assuming one-half this amount, as before = 675 lb.,

$$Y = \frac{9,397}{2} + \sqrt{\left(\frac{9,397}{4}\right)^2 + 675^2} = 9,441 \text{ lb. f. s.,}$$

which, according to Mr. Cole's limit stress would call for a 9½-in. axle.

Recapitulation:—

I. Method of G. L. Fowler and C. J. Mellin calls for a 9-in. axle.

II. Method of G. R. Henderson calls for a 9-in. axle.

III. Method of F. J. Cole calls for a 9½-in. axle.

The diameter found by the writer's method, using the same figures as in the foregoing cases and based on 21,000 lbs. fiber stress is:

Equivalent or combined lever arm equals

$$\sqrt{13^2 + 22^2} = 25.5 \quad P = 70,000;$$

Then the diameter of the axle =

$$\sqrt[3]{\frac{70,000 \times 25.5}{21,000 \times 0.0982}} = 9.47 \text{ in.}$$

Corrosive Effect of Acetylene.—With the increasing use of acetylene gas the risks of its corrosive effect on pipes and metal containers should be better known. Tests have shown that most acetylene, as generated, attacked zinc, lead, brass and nickel to a slight extent; iron was affected six to seven times as much; but copper suffered more than any other metal tested. Copper was quickly changed into a soft, porous black mass. Tin, aluminum, bronze, german silver and solder were practically unaffected. Thus it would appear that copper and brass or other copper alloys should not be used as piping for acetylene-gas supplies, and that iron should be well tinned rather than galvanized or nickel plated.—*American Machinist.*

THE LOCOMOTIVE INSPECTION RULES*

Explanations Which Should Help to Prevent Misunderstandings of New Federal Government Code

BY FRANK McMANAMY

Chief Inspector of Locomotive Boilers, Interstate Commerce Commission, Washington, D. C.

The locomotive inspection law is comparatively new, and is so comprehensive that explanations will no doubt be of substantial value in assisting carriers to meet the requirements. The locomotive inspection law and rules in no way affect or change any of the requirements of the locomotive boiler inspection law or rules. It is true that the form of reports for monthly and annual inspections were changed somewhat, a combination form covering the entire locomotive, including the boiler, being adopted, but this was done to avoid the necessity of requiring additional sworn reports, and not for the purpose of modifying in any way the boiler inspection requirements.

BOILER LAGGING REQUIREMENT

While we cannot assume the duty of advising carriers in every case of the expiration of periods allowed by the rules for making various tests and inspections, it is not out of place to direct attention to the fact that the five-year period for the removal of lagging from all boilers which were in service on June 30, 1911, expires on June 30, 1916, and that before that time they must have had at least one removal of lagging and have had the entire exterior of the boiler thoroughly inspected, as provided by Rule 16. On account of having postponed as long as possible any effort to meet this requirement, some carriers are now adopting the practice of simply removing and replacing the jacket and lagging when the locomotive is in for monthly inspection, and so reporting on Form No. 1. This does not meet the requirements, and Form No. 1 cannot properly be used for making such reports. The purpose of requiring a complete removal of lagging is to permit a thorough inspection of the entire exterior of the boiler, which can only be made while the boiler is under pressure; therefore, hydrostatic test must be applied while the lagging is off, and a report made on Form No. 3.

THE LOCOMOTIVE INSPECTION RULES

In the preparation of the rules which were approved by the Commission in their order of October 11, 1915, effective January 1, 1916, it was considered advisable to follow as closely as practicable the general plan of the locomotive boiler inspection rules, particularly with respect to making inspections and filing reports by the carriers. The purpose of this was to avoid, as far as consistent with a satisfactory compliance with the requirements, inconvenience and expense to carriers in the matter of making reports.

In order to avoid a duplication of reports, combination reports (Forms Nos. 1 and 3) were prepared, which cover the work required by the locomotive boiler inspection law and rules, and also by the amendment to the law and the rules issued in accordance therewith, and take the place of reports (Forms Nos. 1 and 3) previously required and, in general, these reports should be handled the same as the former ones were.

I shall not attempt to explain or define each rule. I will try, however, to make clear those that are somewhat general in their terms, and also any with respect to which numerous questions have been asked.

It will be noted that Rule 1, of the locomotive inspection rules is identical in its requirements with Rule 1 of the boiler inspection rules, and makes the railroad responsible for the general design, construction and maintenance of locomotives and tenders. Rule 2 is identical with Rule 7 of the boiler inspection rules, and makes the officer in charge at each point where inspections are made responsible for the inspection and repair of all locomotives under his jurisdiction. Rule 3 is exactly the same as boiler inspection Rule 8, defining the meaning of the term "Inspector." And they are intended to accomplish the same general results.

RULE 4—DAILY INSPECTIONS

Rule 4 of the locomotive inspection rules reads as follows:

> Each locomotive and tender shall be inspected after each trip, or day's work, and the defects found reported on an approved form to the proper representative of the company. This form shall show the name of the railroad, the initials and number of the locomotive, the place, date, and time of the inspection, the defects found, and the signature of the employee making the inspection. The report shall be approved by the foreman, with proper written explanation made thereon for defects reported which were not repaired before the locomotive is returned to service. The report shall then be filed in the office of the railroad company at the place where the inspection is made.

The general purpose of this rule is to require the present practice of inspecting locomotives daily to be continued, and to avoid, if possible, the necessity of requiring additional sworn reports of inspection. It is the practice of some carriers immediately to conform to a Government requirement that is less rigid than their present system of inspection, apparently overlooking the fact that Government requirements are not shop standards, or intended to represent the general condition of equipment, but are minimum requirements, or limits which mark the point at which the Government will take action to bring about necessary improvement in the condition of equipment. In other words, they represent the extreme condition in which the locomotive will be permitted to continue in service.

This being true, the effect of fixing by rule a monthly inspection only, would be, in many instances, to have the carriers accept that as the Government standard and neglect inspections between those periods. The law was not intended to relieve carriers from inspections which have by years of experience been found necessary, but to insure the performance of these inspections and such others as may be considered essential to proper maintenance of locomotives. Therefore, Rule 4, providing for the usual daily inspection, in addition to the monthly inspection and report, became necessary.

FIXING RESPONSIBILITY

Form 2, which is required by Rule 4, was intended to accomplish two definite purposes: First, to insure an inspection of each locomotive at certain prescribed periods. Second, to require the foreman or officer in charge to know the condition of the locomotive, and to say why defects reported were not repaired before the locomotive is returned to service. One of the reasons for this is that in many cases it is practically an impossibility when an accident resulting from defective equipment occurs, to fix the responsibility for the defects in question. The officers in charge of the work will often insist that the defect was not properly reported or not reported at all; therefore, that they should not be held responsible for failure to make repairs. The person whose

* From a paper read at the Western Railway Club, Chicago, March 22, 1916.

duty it was to report such defects insists with equal vigor that the defect was properly reported, perhaps had been reported numerous times, but had not been repaired. Failure to find the reports of a defect does not always indicate that such reports were not made, because frequently carbon or other copies of such reports are obtainable when the original reports cannot be found.

Rule 4, which requires an inspection after each trip, or day's work, and a report showing the defects found, with the signature of the employee making the inspection, and requiring that the report shall be approved by the foreman, with proper written explanation made thereon for defects reported which were not repaired before the locomotive is returned to service, will assist in definitely fixing the responsibility for operating defective locomotives. It will also require the foreman to exercise more careful supervision over the work, so that he may properly sign the report. These inspection reports must be kept on file in the office of the railroad where they can be checked.

Some railroads are starting out with the evident intention of defeating the purpose of this rule. One of the most common methods is to have two reports, one showing everything in good condition, properly approved by the foreman, which is kept on file; another, which may be the usual work book, or a different report, showing the actual defects and the repairs made.

Railroading has, in a spirit of sarcasm perhaps, been described by a railroad man as "the art of placing the responsibility on the other fellow." I do not agree with this definition, or that it particularly applies to railroad men, because I know that men in other lines of work are as proficient in evading responsibility for improper conditions as some railroad men; but we must admit that it pretty accurately describes practices that are too frequently met with.

One illustration of this is the difficulty we are experiencing in getting Form 2 approved by the foreman, "with proper written explanation made thereon for defects reported which were not repaired before the locomotive is returned to service," as required by the rule. We expected some difficulty in getting the inspections properly made, even though the rule differs but little, if any, from rules which were supposed to be in general use, but we did not expect that it would be more difficult to get the foreman to perform his part of the work than it would be to get a proper inspection made. We were still further surprised to find that the objections of the foremen were not to the approval of the report, as that is a comparatively small matter, but the requirement that "proper explanation must be made thereon for defects reported which were not repaired" appears in many cases to be out of tram with their ideas of the duties of a foreman, and many of them resent being required to say why defects reported were not repaired.

LACK OF SUPERVISION

If I were to be asked what in my opinion is the principal cause of locomotives being operated with defects which are violations of the rules, I would without hesitation say that the one important cause is lack of proper supervision. The average workman in any line of work will follow the standard set for him by, and which is acceptable to, the person in charge of the work; or, in other words, they will give you just what you will take. It avails nothing to fix a high standard by rule, and then day after day, on job after job, accept work that is way below the standard thus set. This willingness to accept work that is below the standard, or failure to observe that it is below the standard, has a demoralizing effect on the force and is the principal cause for poor work being turned out.

In one instance a general officer of a railroad asked if there was not some way of being relieved from making out Form 2, stating that the mechanical officers had informed him that they did not understand how they could hold their positions under the new rule which made it necessary to report actual conditions and show a record of the work not performed, with the reason. Upon being asked if the new rules would cause defects on their locomotives, he admitted that they would not. Further questioning brought out the admission that the only effect of this rule would be to require the officer in charge to assume the responsibility for sending locomotives out in a defective condition, and without repairs being made to defects which were reported.

The mechanical officers on the road in question appeared to be perfectly satisfied to have the locomotives continue in service in a defective condition so long as they did not have to sign a report assuming the responsibility by showing that the defective condition had been reported and not repaired, and that the return of the locomotive to service without proper repairs had been approved. When that happened they immediately advised the general officers that under the new rules they did not see how they could hold their positions.

Some of the principal requirements in Rule 4 about which there appears to be some misunderstandings are covered in the following explanatory circular, which was recently issued:

CIRCULAR No. 123

In reply to numerous inquiries relative to the inspections after each trip or day's work, as required by Rule 4 in the Commission's order of October 11, 1915, and to provide for a uniform compliance with its requirements, the following explanations are given:

In road service, the word "trip" as used in this rule ordinarily means one way over a division or district. On branch or turn-around runs where one round trip is made in a day, "trip" will be held to mean "round trip."

In suburban, transfer, or short branch line service where more than one round trip is made each day, also in yard service, "day's work" (instead of "trip") will apply.

For locomotives which make one or more round trips per day, with one end of the run a shop point, inspections made daily at such points will be accepted as meeting the requirements of the rule, even though the day's work is not completed there.

In work-train or other service in which locomotives are tied up at outlying points where repairs cannot be made, inspection reports may be sent to the terminal at which the locomotive is cared for.

For double-crewed locomotives in yard service, where crews change in the yard, one inspection and report each 24-hour period will be required. This may be made when the locomotive is taken in for fuel, water or fire-cleaning; where such locomotives do not go to the shop for this, an inspection period must be provided, and the inspection as provided by the rule made once each 24 hours.

The above explanations are not intended to reduce the number of inspections required by the rule, which are minimum requirements.

In this connection it is well to say at this time that the explanation of Rule 4 shown on page 41 of the explanations of rules issued by the Special Committee on Relations of Railway Operation to Legislation is one with which we cannot agree. The explanation reads as follows:

"Any employee the railroads designate can sign the report instead of the foreman."

This was issued without having been submitted to any representative of the Government, and cannot be accepted, because it is contrary to the very purpose of the rule, inasmuch as under it a call-boy, roundhouse foreman's clerk, or any other employee could approve reports for repairs of which he knew absolutely nothing.

WHO MUST SIGN REPORTS

We have stated that at large terminals where the roundhouse foreman or general foreman is unable to approve the reports on account of lack of personal knowledge, the approval of the gang foreman or the mechanic in direct charge of the work would be accepted, because of his having personal knowledge that the work had been properly performed; but we will not accept the report approved by some employee who does not have such knowledge.

The requirements of Rule 4 are identical with the system which has been said to have long been in force on many or practically all important railroads in the country. The instructions shown on the form of report are, in effect, the same as those contained on similar reports which have been

in general use. The only difference is that now there is a Federal requirement that these inspections be performed and the defects reported, and that the foreman shall say why repairs were not made, while prior to January 1, 1916, it was a requirement of the carriers only, and, as was stated by one general manager, "There is a great difference between a Federal rule, which must be observed, and the same rule adopted by a railroad company, which may be varied from at pleasure." Rule 4 and Form 2 simply continue in force what has been said to have long been the general practice with respect to locomotive inspection.

ASH PAN REQUIREMENTS

Rule 5 cannot, and was not intended to, modify or change the act of May 30, 1908, known as the ash pan act, requiring every locomotive to be equipped with an ash pan which can be dumped and emptied or cleaned without the necessity of an employee going under such locomotive. It was intended to, and does, provide that such ash pans shall be securely and properly attached and supported, and that the operating mechanism shall be properly arranged and maintained in a safe and suitable condition for service. Our inspections have disclosed numerous cases where ash pans are not maintained in accordance with the requirements of the law, the best evidence of which is the fact that it is an easy matter to find some man under a locomotive hoeing out the pan, because the devices for cleaning it are inoperative or inefficient.

ORIFICE TESTS OF AIR COMPRESSOR

Rules 6 to 15 cover the inspection and condition of brake and signal equipment, and provide, first, for an inspection before each trip, to see that the brakes are in a safe and suitable condition for service; second, for a service test to show the general condition of the compressors.

One of the points on which the most numerous requests for information have been received, is the method of making an orifice test of an air compressor, and where the fitting containing the orifice disk should be attached. That is a matter on which we are not going to make a positive rule, because the orifice must be attached at some point where it will receive the supply of air from the compressor. The usual method is to attach it to the main reservoir, which is entirely satisfactory to us. If, for convenience, it is desired to attach it to the brake pipe at the rear of the tender, we will not object, because that is a more severe test than the rules require, inasmuch as the compressor must also supply any brake pipe leakage that may exist.

"CLEANING WITH STENCIL AND PAINT BRUSH"

Tests of distributing or control valves, reducing valves, triple valves, straight-air double-check valves, dirt collectors, and brake cylinders are also required at regular intervals, and a choice of three methods of recording the date of these tests is given. That is, it may be stenciled on the parts, stamped on metal tags attached thereto, or displayed on a card under glass in the cab of the locomotive.

The rules so far have not required sworn reports of these tests to be filed, but the practice which we find is being followed on some railroads indicates that such a rule may become necessary, as we have found that the practice which has long been too general on repair tracks of "cleaning" triple valves and brake cylinders on cars by means of a stencil and paint brush, is being adopted for locomotive practice, and dates of testing and cleaning are being placed in the cab without any work having been performed. In a number of instances the date shown has been one on which the locomotive was not at the terminal at all. This practice, if followed, will surely result in a change of the rule requiring such reports to be sworn to, placing a greater measure of responsibility on the inspector and officer in charge.

CLEAR VISION WINDOWS

Rule 16 covers the condition of cabs, warning signals and sanders, and attempts to provide for a reasonable view of the track and signals for the enginemen. One of the requirements which seems to be not generally understood is that relating to clear vision windows. It may be, perhaps, that the description of this window is not as complete as it might be. The term, however, indicates what is desired, and should in itself prevent the application of some of the windows which were designed to be used under this requirement. I refer particularly to the type of window, supposed to meet this requirement, which has a wooden frame from 1 in. to 2½ in. in width across the front cab window directly in the line of enginemen's vision. This surely could not under any circumstances be called a "clear vision" window. What is desired is not an obstruction, but something that will give an unobstructed view of the track and signals during stormy weather. On the best types the glass is securely attached to a frame at the top and sides only, leaving no obstruction across the center of the window at the bottom of the opening. Such a window will not obstruct the engineman's vision in any way when closed, and in stormy weather, if opened slightly, it will give the engineman an unobstructed view of track and signals, which cannot be obtained with his head out of the side cab window in a severe snow or rain storm.

TIMES FOR TESTS AND INSPECTIONS

Misunderstandings with respect to the periods within which the various tests and inspections required by the locomotive inspection rules must be performed have caused some confusion, and are resulting in some instances in carriers making an extra effort to make tests which might properly, and perhaps more satisfactorily, be made at a regular inspection period, and in other instances failing to make tests which should be made at inspection periods, and which will cause additional expense and delay to equipment when they are required later.

To make this point clear, beginning January 1, 1916, which is the date the locomotive inspection rules became effective, all tests or inspections required by them should be made within the prescribed periods. That is, inspections required monthly should be made within the first month, inspections required quarterly should be made within three months; and inspections required annually should be made within the year. This permits inspections required under the locomotive inspection rules to be made at the time the boiler inspections are made, and avoids the necessity of holding locomotives especially for this inspection.

When the locomotive is held for inspection, all of the work should be done; otherwise, it is sure to cause inconvenience later. To illustrate: Hydrostatic test of main reservoirs is required at least once each year. The intent of this clearly was that this test should be made when the hydrostatic test is applied to the boiler, but we are receiving annual reports from many roads showing hydrostatic test applied to the boiler, but none to the main reservoir. This is not only a failure to comply with the intent of the rule, but is sure to result in an inspector ordering the locomotive held to have this work done, and it may occur at a time which will be very inconvenient.

DRAW GEAR INSPECTIONS

There has been some question as to the proper answer to item 6 on Form 1, with reference to the condition of draw gear between locomotive and tender. Rule 22 provides in part that—

> The pins and drawbar shall be removed and carefully examined for defects not less frequently than once in three months.

This has been interpreted by some to mean that the condition need be shown but once in three months, but it simply

provides a particular inspection for the pins and drawbar which should be made. The first sentence of the rule requires that—

The draw gear between the locomotive and tender, together with the pins and fastenings, shall be maintained in safe and suitable condition for service.

Which means not only the drawbar and pins, but also the safety bars or chains, with their fastenings; therefore, they must be known to be in good condition, and so reported on each monthly report in answer to item 6. When the drawbar and pins are removed to make the special inspection required by the rule, that should also be indicated on the report. The remaining rules follow, with some slight modifications, the standard practice recommended by the Master Mechanics' Association, which should be so well understood that explanations are not necessary.

ACCIDENTS REPORTED

Up to March 1, accidents reported to us under the locomotive inspection rules had killed 7 and injured 113 persons, and we know that, perhaps on account of failure to fully understand the requirements, all were not reported. Among the most serious, as well as the most frequent, class of accidents are draw gear failures, allowing locomotive and tender to separate, 14 accidents of this character, resulting in two killed and 13 injured, having been reported. Twenty-two persons were injured by defective reversing gear. Broken spring hangers have caused two deaths and six injuries. Cylinder-head failures have killed one and injured six.

A general classification of accidents due to failure of parts of the locomotive and tender covered by the amended law has not been made, but is sure to be surprising. It is our purpose to investigate them carefully, and classify them, giving the cause. After a year or two of such work sufficient data will be available to enable not only the representatives of the Government, but of the railroads, to systematically and effectively labor to remove the causes, and thereby reduce the number.

CHATTERING WHEEL SLIP IN ELECTRIC LOCOMOTIVES*

BY G. M. EATON

When the steam pressure in the cylinders of steam motive power is high enough to start slipping of driving wheels, their acceleration is fairly uniform and rapid, the load on the piston being well sustained on account of late cut-off and stored steam in pipes, etc. In contrast to this, with electric motive power, regardless of the method of transmitting the tractive effort from the rotors to the wheels, the acceleration after slipping starts is liable to be erratic, being dependent upon the distribution of rotating masses, and upon the characteristic of the coefficient of friction between wheel and rail.

The fundamental difference between the running gear of steam and electric motive power is that in the steam locomotive the only moving parts having relatively high moments of inertia are the driving wheels. In an electric locomotive, the moment of inertia of the rotors, especially when operating through a gear reduction, may be as great as or greater than that of the driving wheels. The combined inertia of connecting rods, cross-heads, piston rods and pistons is practically negligible as far as it affects acceleration of driving wheels after slipping starts.

In an electric locomotive, when slipping occurs, the sequence of events is as follows, regardless of the type of drive: Current is applied to the motor and the rotor starts to turn. Clearances in the entire transmission mechanism are first eliminated. Then, as the torque is increased, the metal of the transmission, framing, etc., is bent and twisted, or otherwise deflected. This stressed metal becomes a storage battery of energy. Finally the tractive effort reaches a value sufficient to overcome the existing adhesion at the rail (coefficient of friction of repose), and the wheel starts to slip. The instant relative movement occurs between wheel and rail, the coefficient of friction drops from that of repose to that of relative motion. There is, therefore, an opportunity for the stressed metal to start discharging its stored energy, since part of the resisting force has disappeared. This energy is expended in accelerating the wheels ahead of the angular position they occupied relative to the rotor at the instant slipping started. Since the wheels are being accelerated ahead of the rotors, the rotors are losing their load and will tend to speed up.

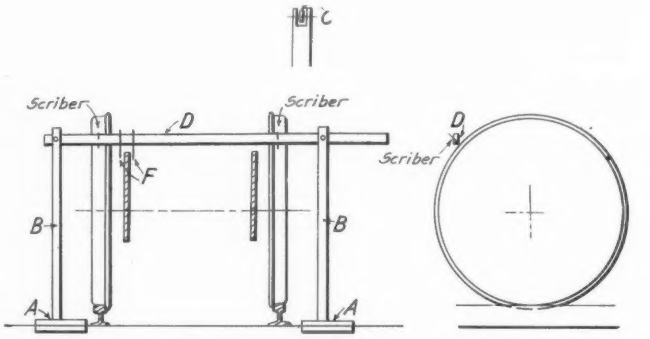


Fig. 2—Hand-operated Oscillograph for Recording Chattering Slip on the Wheel Tread

Analyzing next the other division of the system, the adhesion at the rail will decrease as the velocity of the wheel tread relative to the rail increases. The effort being transmitted through the transmission system, however, will decrease very rapidly, due to expenditure of stored energy, and as soon as this effort, which is tending to accelerate the wheels, becomes less than the adhesion at the rail, which is tending to retard the wheels, the wheels will evidently start to slow down.

There are, then, two sets of rotating masses mechanically coupled, the masses at one end of the system accelerating and those at the other end retarding. As soon as clearances in the transmission are taken up, there is liable to be a jolt on the mechanical system, accompanied by a recoil. This

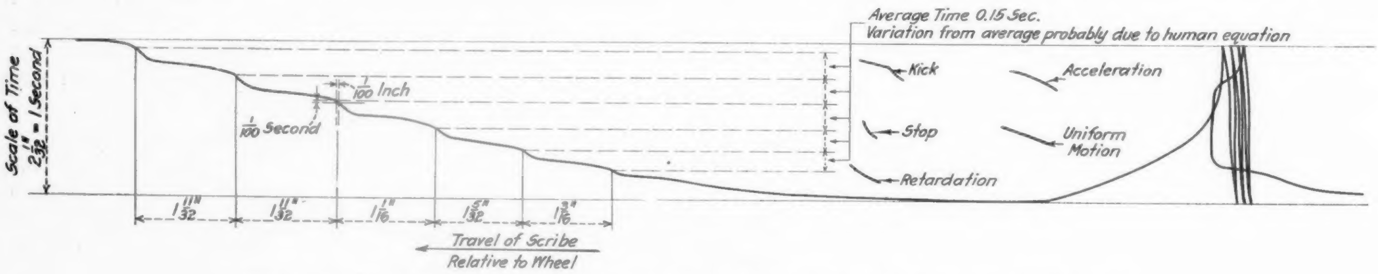


Fig. 1—Oscillograph Record of Chattering Wheel Slip Made Directly on the Wheel Tread

*From a paper presented before the American Institute of Electrical Engineers in New York, February 9, 1916.

gives the setting for chattering action, and such action has been experienced in practically every type of electrically-driven rolling stock where the motors are sufficiently powerful to slip the wheels at high adhesion.

On the Norfolk & Western locomotives, after they had been in service for some months, evidences of failure were detected in the crank pins. The cause was traced to chattering slip by means of a rough oscillograph, as shown in Fig. 2. The brakes were set on three trucks, and the oscillograph frame was set up on the fourth truck. The wheel tread was chalked. The oscillograph frame was oscillated about its supporting points A, the amplitude of oscillation being two inches. The time of complete oscillation was two seconds. The scribers were pressed against the wheel treads, which were then slipped, and the characteristic diagram of the chattering slip was obtained, as showing in Fig. 1. The analysis in the figure is self-explanatory. By means of this diagram, it was possible to figure approximately the forces

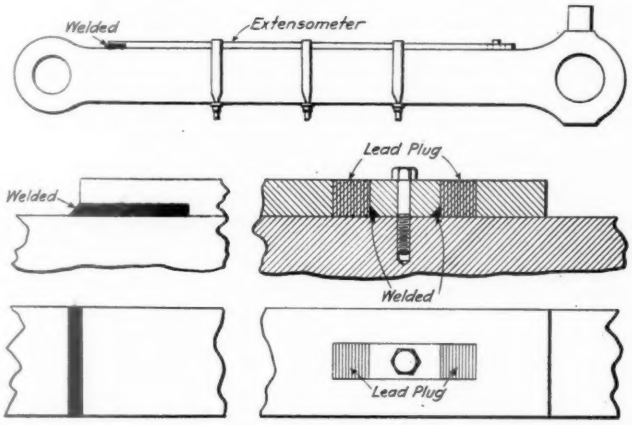


Fig. 3.—Details of Extensometers Used to Check the Oscillograph Figures

necessary to produce the acceleration and retardation which occurred, and the resultant stresses in the rods, pins, etc., were calculated.

To check the oscillograph figures, extensometers were arranged, as shown in Fig. 3, by means of which the connecting rods indicated their own stresses. The extension and compression of the rods were recorded by means of the compression of blocks of lead. The two methods checked within a very few per cent. On the basis of the results, new rods, pins, etc., were applied on the locomotives. These have proved adequate for the service.

This chattering slip was more evident on the Norfolk & Western locomotives than could have been anticipated, since this was the first time electric haulage had been applied in service where such extremely high tractive efforts were required.

ANTIFRICTION A MISNOMER.—Antifriction metals, so called, are useful for lining bearings chiefly because of the ease with which they can be formed (poured) and their ability to permit crushing and abrasion without great increase in friction, not because they have a lower coefficient of friction; hence antifriction is a misnomer.—*Power.*

REMELTING BABBITT METAL CAUSES INFERIORITY.—When babbitt metal has been remelted a number of times, it loses its fluidity, becoming more "pasty" or "mushy" the oftener it is remelted, and will not make as sharp, smooth and solid castings for bearings as when the metal is new. This probably is due to separation of the ingredient metals resulting from oxidation of those of lower temperature of fusion, when raised to much higher temperatures than may be necessary for the fusion of other ingredients.—*Power.*

THE PREVENTION OF SPONTANEOUS COMBUSTION OF COAL

BY J. F. SPRINGER

Spontaneous combustion has been a source of much trouble and of considerable loss wherever coal has been stored in large quantities and many independent investigations have been made, all of which are in substantial agreement as to the underlying causes. In a previous article* the writer has endeavored to set forth what these causes are and to outline the conditions favorable to ultimate self-firing.

From a practical standpoint one of the most important discoveries which has been made is that spontaneous combustion is due to accelerating oxidation and rise of temperature, the one activity continually boosting the other until actual ignition takes place. There are, accordingly, two remedies: first, to shut off the oxygen supply; second, to keep down the temperature.

The submergence of coal in water performs both of these functions. Bituminous coal stored under water, whether salt or fresh, is proof against self-firing. Submerged storage is further beneficial in that it preserves the thermal content and physical condition. New River, W. Va., coal, 1/4 in. in size, stored in salt water at Portsmouth, N. H.; Norfolk, Va., and Key West, Fla., either lost nothing at all of its heating value or the loss was less than .5 per cent. Similarly, the same coal of the same size, stored beneath fresh water at Pittsburgh, Pa., lost none of its heating value. In all of these cases the coal was stored two years. Parr and Hamilton in an investigation conducted under the auspices of a university in the middle west found that the heating value of submerged Illinois coals remained practically the same after a period of about nine months. All the coals were submerged when freshly mined, the interval between mining and submergence in no case exceeding one month. About the only objection to this method of storage seems to be that it requires the firing of wet coal. This is a real objection where Illinois and Wyoming coals are used, as they mechanically retain 5 to 15 per cent of water after draining. In the case of high-grade eastern coals, however, if firemen are permitted to wet down their coal before firing, in order, as some say, "to make a hotter fire," the addition during storage of the 2 or 3 per cent of moisture which these coals retain becomes of little consequence.

The capital outlay required to provide for submerged storage will differ with varying conditions. Where the storage is located on tide water or can be placed on the bank of a fresh water stream, the cost of construction would not appear to be necessarily unreasonable. On the other hand, where a special water-tight basin has to be constructed, the expense may be considerable.

The United States Government has wet storage in salt water in the new coaling stations at Cristobal and Balboa, Canal Zone. At the former station, which is the larger of the two, the capacity for wet storage will be about 100,000 tons. This will be for navy coal and not subject to the demands of commerce. The coal will be piled up above the sea level to a considerable height and there will be dry storage adjoining.

At a zinc smelting plant in Illinois consuming several hundred tons of screenings a day the problem of storage was solved by utilizing an abandoned excavation at a brickyard near by. The pit was 450 feet long, 250 feet wide and 45 feet deep. No lining aside from coal screenings at 45 cents a ton was found necessary and a storage basin for 100,000 tons was thus prepared at a very small outlay. The coal is delivered through a chute in which water is used to facilitate the movement and is recovered by a pumping operation. The total cost of handling, including interest and amortization on

*See the *Railway Mechanical Engineer* for March, 1916, page 124.

the plant, the depreciation of the coal, etc., amounted to 22.5 cents per ton. The originator of this system states that experiments have shown that with properly designed equipment equally as good results may be obtained with coal not coarser than will pass through a 6-in. screen.

The use of carbon dioxide presents another possible means of cutting off the air supply from coal piles which might be applied under some conditions. Quantities of this gas are available in flue gases, which could be diverted and cooled. Its weight would then permit its use as a blanket over the coal pile to exclude the air, it being necessary, however, to provide a storage basin whose bottom and sides are air tight. Probably the greatest difficulty would be adequately to provide against dissipation of the carbon dioxide through the action of winds across the top of the storage basin.

The second remedy against spontaneous combustion seeks not to cut the air off but to supply it in quantity. Ignition will not take place until the temperature has risen to 600 deg. F. or higher. If the circulation of air is sufficient to carry away the heat liberated by the oxidation process oxidation may still continue, but will be slow and will not result in ignition. It has been suggested that the system of ventilation should be so arranged that the currents of air do not come in direct contact with the coal. In this way, the cooling effects may be obtained without exposing the coal to the oxygen supply in the flowing air.

Ventilation has been tried, apparently with some success, at Montreal in the 250,000-ton storage of the Canadian Pacific. That it is not always to be depended upon, however, may be illustrated by a case taken from experience in the Philippine Islands. A coal is mined on the island of Batan which changes its condition rapidly upon exposure to sun and air, losing its lustre and disintegrating into powder. Even in transit it is necessary to protect it from sun and wind to prevent this rapid alteration of condition. Several years ago 9,000 tons of this coal were stored by the Philippine civil government in piles about 15 ft. high, the piles resting on the ground and being protected by a roof. They were ventilated with alternate tiers of horizontal air passages, about 19 ft. 6 in. apart and at right angles to each other. The coal did not actually ignite, but the timbers used to make the ventilators were all badly charred.

So far our attention has been occupied with measures which are somewhat elaborate and expensive. It is, no doubt, often the case that nothing approaching any one of these remedies is practical. Perhaps the most important of the precautionary measures which must ordinarily be depended upon to prevent spontaneous combustion is to store the coal only in low piles. As already pointed out in the preceding article, the safe height will vary for different coals. Heights greater than 15 or 20 ft., however, are generally dangerous. Another precautionary measure is to avoid breaking up the coal when putting it into storage. The fracturing results in the exposure of fresh surfaces to oxidation. Fine coal produced by handling tends to run down into the interior of the pile and, especially when freshly broken up, is highly susceptible to oxidizing influences. Furthermore, the interior of the pile is the dangerous region.

More than ordinary care should be bestowed upon the storage of those coals which contain unsaturated compounds which are ready to absorb more oxygen. Although this process does not result in the formation of carbon dioxide, it nevertheless causes a rise in temperature. If the coal contains sulphur in the form of iron pyrites, another source of oxidation is present. The oxidation of iron pyrites is greatly accelerated when the coal is in a finely divided state and is also increased by the presence of moisture.

In a report on this subject by Porter and Ovitz, among other precautionary measures, it is recommended that coal should be rehandled and screened after the lapse of two months, and that storage be delayed for a period of six weeks after mining to permit the coal to "season." Piling the coal in such a way that the lump and slack is distributed is also recommended. The lump should not be permitted to roll down from a peak to form air passages.

Where the water supply could be obtained by diversion from a nearby stream it might be practical under some conditions to provide a system of water cooling by means of pipes through the coal pile. The piping might be permanent and so arranged as to interfere but little with the recovery of the coal. Of systems which have actually been tried, however, submerged storage is the most important and best meets the requirements. Where submerged storage is not permissible, the best practice is to store in shallow piles, leaving frequent aisles between. As a means of frequently testing the temperature until the danger period is past, iron rods may be thrust down into the mass at various points. These should be pulled out and examined every few days until the temperature begins to drop. Where excessive heating or actual fire occurs, the very best method of attack is to dig out the heated coal. The use of water usually fails if the case of firing is really a bad one, because of the formation by the fire of a protective covering of coke which prevents the penetration of the water.

FUEL ECONOMY ON THE ROCK ISLAND

W. J. Tollerton, general mechanical superintendent, Chicago, Rock Island & Pacific, in an article published in the March issue of the Rock Island Employees' Magazine, mentioned briefly the results of the systematic fuel economy campaign on that road and called attention to the possibility for further improvements. He said in part:

"The special department to effect economies in the consumption of locomotive fuel, under the general direction of the mechanical department, was organized in January, 1913. During the calendar year of 1915, as compared with the calendar year of 1912, on the basis of cost of fuel per 1,000 gross freight ton-miles, per 1,000 gross passenger ton-miles and per switch engine-mile, a reduction of $1,010,681.84 was effected in the cost of locomotive fuel. I will not attempt to apportion the credit for this showing, as it was simply due to the co-operation of all employees, and they are to be congratulated on this excellent performance.

"There are still very large opportunities for making further substantial reductions in the cost of locomotive fuel. For instance, during the fiscal year ended June 30, 1915, in freight service there was an average consumption of 16 scoops of coal per engine-mile, in passenger service 7.4 scoops per engine-mile and 9 scoops of coal per switch engine-mile. If a reduction of only one scoop of coal per freight engine-mile and one-half a scoop of coal per passenger and switch engine-mile can be effected, the following annual saving would result:

Freight service, 131,022 tons	$294,799.50
Passenger service, 67,496 tons	151,864.75
Switch service, 24,045 tons	54,101.25
	$500,765.50

"It is felt that with the continued co-operation of all concerned these figures could be exceeded. The main factors to be considered in accomplishing such a result are:

"Complete work reports by the engineers and prompt repairs by the roundhouse forces. This is also of vital importance in connection with the Federal requirements.

"Properly sized coal delivered to the locomotive tender.

"Locomotives should not be fired up an undue length of time in advance of the time they are needed, and care should be taken in building the fire.

"Proper instruction and co-operation of engine crews and terminal employees in the proper and economical performance of their duties."

CAR DEPARTMENT

QUALIFICATIONS AND TRAINING OF CAR INSPECTORS

BY MILLARD F. COX

The training of car inspectors does not vary materially from the training of men in every walk of life, for specific expert work; it is a process without short cuts. There was a time when nearly all railroad men were supposed to have been brought up through a long course of apprenticeship. These conditions have changed; all men nowadays are specialists, more or less. To say that a man can do anything is more than apt to create a doubt at once as to his ability.

In order to test the practicability of the system employed on the road with which I am connected, I sent a brief communication to one of our general car inspectors, asking him to answer a number of questions categorically. They are given below, with his replies:

(1) *Where do we get our Car Inspectors?*
As a rule we select from car repairers and car oilers the most intelligent and active man.

(2) *How do they master the Rules of Interchange?*
We supply them with the M. C. B. rules and instruct them to read and memorize them as much as possible.

(3) *How are these men trained and developed?*
When selected, we instruct a man in a general way what we expect of him, and that his continuance as an inspector will depend entirely on his conduct and the way he performs his duty. Then we place him in a location where there is more than one inspector working so that he is a constant partner or understudy to an experienced inspector. Later, when from daily observation we see that he is doing well, we can transfer him to a place where there is but one inspector.

(4) *Do they get any special training?*
As stated in No. 3, practical experience and such constructive criticism as from time to time may be rendered against or in favor of their work.

(5) *What are the requisite qualities for a good inspector?*
Honesty, sobriety, firmness of decision, loyalty, and intelligence.

(6) *Should he be a mechanic?*
This is not absolutely necessary if in train service, but in the shop or on new work, he should be a mechanic.

(7) *What opportunity has he to advance in the service?*
If in train service, he might from time to time advance to become a foreman of inspectors, or general inspector. If in the shop, to a gang foreman, shop or general foreman.

The necessary qualifications for a good car inspector might be enumerated at considerable length. The essentials are a clear head, an accurate memory, keen, quick eyes, and sound judgment. Without some of these, he cannot hope to reach any remarkable distinction. I once knew a man—the foreman of a large shop—who was one of the best organizers and disciplinarians I ever saw; and yet he was almost invariably under the influence of liquor. His legs were often shaky, but his head, never. Not many men are so constituted, and it is just as well that they are not.

Sound judgment will almost stand for all the other essentials mentioned, if it is genuine. Sound judgment is common sense, and common sense is sometimes uncommonly scarce among inspectors, other than those who confine their efforts to cars. One of the most energetic inspectors I know is a man who knows everybody, much in general, and little about his own particular business. He could always tell what might, would or should happen, but when it did, his idea was the last to be accepted. His judgment is faulty.

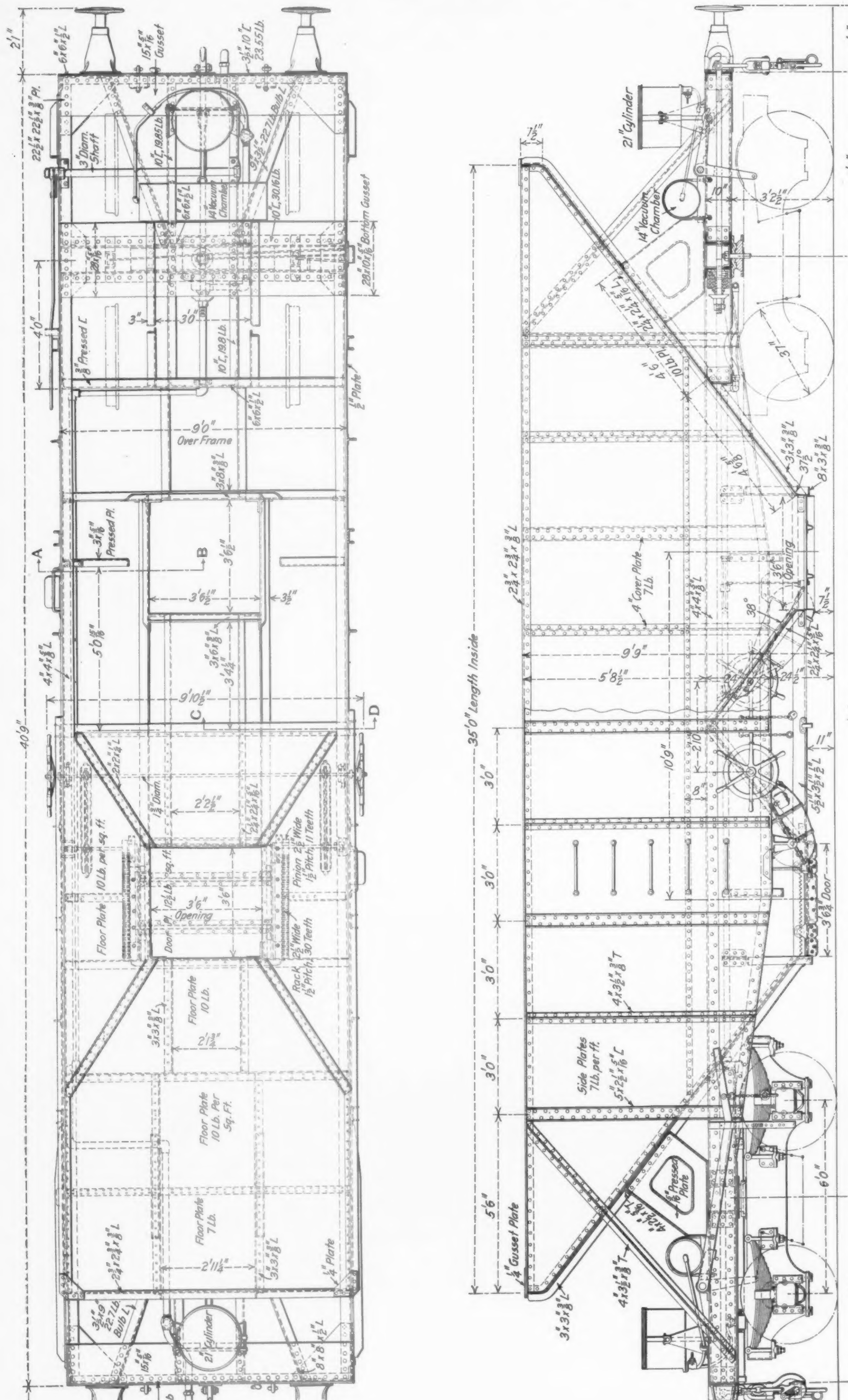
The wide-awake, energetic inspector should be a man of ideas. Opportunities are now, and always will be open to the man with an idea, whether a car inspector or not. They need not necessarily be new, as all ideas are said to be "old things forgotten and found again." Such a man will be classed as a thinker, and the right word at the right time is effective. To think is to evolve, and if this process is repeated often and long enough, something will come to pass. A mechanical inspector without an idea is about as "dry pickings" as anything I know of.

The rules governing the interchange of cars are not as complicated as they will be. No normal human being can ever hope to be able to answer off-hand every question that arises regarding interchange; nevertheless, these rules must be studied and understood, or the inspector will lose his job, and before being discovered, damage the officer higher up. Therefore, he should have a clear head and accurate memory.

He will occasionally make a mistake, and when this occurs, it is ours to reason with him; and here is where he will prove himself if he is made of the right stuff. If by talking the matter over you find him nervous, high-strung, making you feel that you have not advanced a peg toward convincing him one way or the other, talking as it were in a circle, cut it short right then and there; you have struck a hopeless case. If on the other hand, he shows an inclination to prove his case calmly with facts and reason, showing an intelligent grasp of the meaning of the rules, encourage him.

Occasionally, superior men are discovered by accident. I once lost a very valuable foreman. He was so essential to our organization that I was puzzled for a while when he announced his intention of quitting. There did not seem to be one man in the department who could fill his place. In my dilemma, I appointed a man temporarily who, though a very skilled workman, had never shown one leadership trait. To my amazement, he seized this opportunity and in a short time had matters well in hand and proved entirely satisfactory. Here was a man so modest that it made his discovery well-nigh impossible. Our car inspectors must, when in the right, know how to assert themselves occasionally. Aggressiveness in an inspector is a fine quality; such a man never lets an obstacle go unsurmounted. If something unusual should get by him, he must be man enough to acknowledge it squarely, so as to be fully and clearly understood by his foreman. To go home after a long, strenuous day's work, feeling in your mind that however slow or plodding John seems to be, you know that whatever he tells you is absolutely correct, is a comforter of no mean proportions.

A car inspector's knowledge must be gained by hard study and close application, to be of real and lasting value to himself and to his employer.



General Arrangement of the Bengal-Nagpur Hopper Car

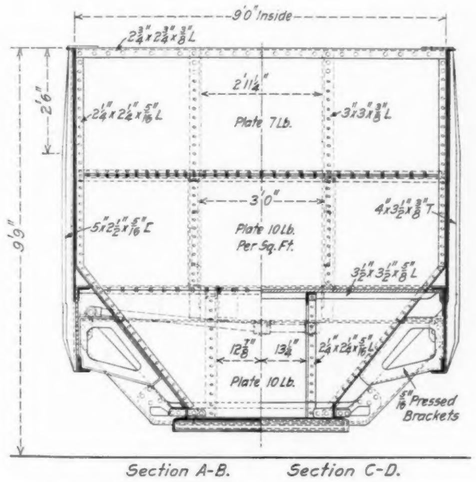
Hopper Coal Cars for India

Steel Equipment for Use on a Road With 5 ft. 6 in. Gage; Capacity, 94,000 lb.; Weight, 49,000 lb.

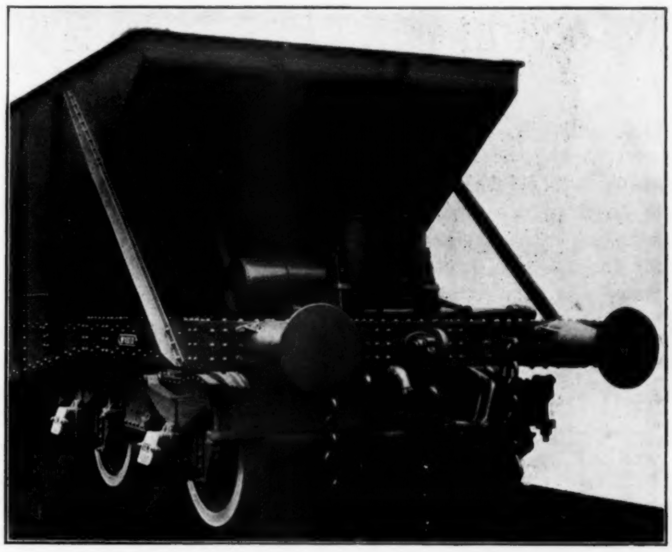
An interesting design of hopper coal car has recently been worked up by the Birmingham Railway Carriage & Wagon Company, Ltd., Smethwick, England, and 66 of these cars built for the Bengal-Nagpur Railway, which is a 5 ft. 6 in. gage road. The cars have a capacity of 94,000 lb. and a light weight of 49,000 lb.

The framing is built up mostly of structural shapes and plates, although pressed material is used in some instances. The side sills have 4 in. by 4 in. by ⅝ in. top and bottom angles with ½ in. web plates, and are 10 in. deep at the ends and 24 in. deep at the center, this depth being maintained for a distance of 10 ft. 9 in. The side stakes are 5 in. by 2½ in. by 5-16 in. channels and 4 in. by 3½ in. by ⅜ in. tees, the depth of the car side being 5 ft. 8½ in. The inside length of the car at the top of the hopper is 35 ft. and the top members of the body frame are 2¾ in. by 2¾ in. by ⅜ in. angles.

As will be seen from the illustrations, the car is so supported on the trucks that the hopper hangs between them and comes close to the track at the bottom. The center sills are 10 in. channels, weighing 19.85 lb. per ft. and extend between the 3½ in. by 10 in. channel end sill and the body bolster which is built up of 10 in., 30 lb. channels and top and bottom cover plates 28 in. by 5-16 in. The center sills are continued to a point 4 ft. beyond the center of the body bolster where they are connected to a ⅜ in. pressed transverse channel, this channel being at the hopper slope. Diagonal braces consisting of 9-in. by 3½-in. 22.7 lb. bulb angles extend between the body bolsters and the buffers. The cars are braced from the sides of the body to the side sills by 4 in. by 3½ in. by ⅜ in. tees and at the center sills by 5-16 in. pressed plate gussets.



Cross Sections of the Hopper Car


An End View of the Hopper Car

The plates used in the body are for the most part 7 lb. and 10 lb. per sq. ft.

The trucks are of a built up type, the frame used being made of ⅝ in. plates with channel transoms and end sills. They have 37 in. diameter wheels and a wheel base of 6 ft., the distance between the center pins being 29 ft. 3 in. The hopper doors are operated horizontally by racks and pinions through the medium of Bramptons' rail chains which are enclosed in special cases, the gearing being operated by hand wheels on either side of the car. The brakes are of the combined vacuum and hand lever type, having 21-in. cylinders with separate 14 in. diameter vacuum chambers. Both brakes operate on all the wheels of the car.


Steel Hopper Car Built in England for the Bengal-Nagpur Railway

The cars were tested with a load of 179,000 lb. or 44,800

lb. per axle without any trouble resulting. The following table gives a list of the principal dimensions:

Length over buffers	44 ft. 11 in.
Length over end sills	40 ft. 9 in.
Length of body	35 ft.
Width of underframe	9 ft.
Centers of trucks	29 ft. 3 in.
Wheels, diameter	3 ft. 1 in.
Wheelbase of trucks	6 ft.
Buffer height (unloaded)	3 ft. 7½ in.
Journals	5½ in. by 10 in.
Hopper doors openings	42 in. by 42 in.
Centers of hoppers	10 ft. 9 in.
Height of car from rail	9 ft. 9 in.
Weight	49,000 lb.
Capacity	94,000 lb.

TABLES FOR DETERMINING THE MOMENT OF INERTIA OF RECTANGLES

BY C. H. FARIS

Since the recommendation of the committee on car construction of the Master Car Builders' Association that the minimum strength for steel underframes be determined on the basis of the stress to end load in the center sills, frequent investigations are required to determine whether certain designs will meet the requirements outlined by the committee. Such investigations, as well as any investigation of the properties of other sections in an analysis of the stresses in steel car members, usually involves the tedious computation of the moment of inertia of a number of rectangles into which a diagram of the section has been divided.

The accompanying tables have been prepared with a view to simplifying the computations necessary to determine the moment of inertia of sections which are treated in the manner outlined above. In Table I are given the values of $\frac{h^3}{12}$ for values of h from zero to 13 by sixteenths of an inch, Table II containing similar information for values of h from 14 in. to 41-⅞ in., varying by eighths of an inch. By using the tables the moment of inertia of any rectangle can be found by simply multiplying the tabular value corresponding with the height of the rectangle by its breadth.

The tables may be applied to the finding of the moment of inertia of a triangle by the use of the formula shown in Table II. For ordinary use the values for intermediate heights may be obtained with sufficient accuracy by interpolation between the values given in the tables.

Fire Damage to Electric Generators.—The chances of generators of the older types being seriously injured by fire in the event of some part of the insulation failing are slight. Their freedom from fire damage is due principally to the comparativey low speeds, the accessibility of the combustible insulation, and the large mass of the machines per unit of capacity. In the case of generators of the turbo type this condition is reversed. Undoubtedly manufacturing companies have given the subject serious thought, but there is still very much to be desired. Besides improving the non-combustible properties of the coverings, it would seem feasible to provide means for cutting off the ventilating system and thus diminish the supply of oxygen, or even to introduce CO_2 in the place of air in the cooling system.—*The Engineer.*

Table I

Moments of Inertia of Rectangles for variable depth h and breadth $b = 1$

	0	1	2	3	4	5	6
0	......	.08333	.66667	2.2500	5.3333	10.417	18.000
1/16	.00002	.09996	.73114	2.3936	5.5873	10.812	18.568
⅛	.00016	.11865	.79964	2.5431	5.8491	11.218	19.149
3/16	.00055	.13955	.87229	2.6988	6.1190	11.633	19.741
¼	.00130	.16276	.94922	2.8607	6.3971	12.059	20.345
5/16	.00254	.18842	1.0305	3.0289	6.6835	12.494	20.961
⅜	.00439	.21663	1.1164	3.2036	6.9784	12.941	21.590
7/16	.00698	.24754	1.2068	3.3849	7.2817	13.397	22.232
½	.01042	.28125	1.3021	3.5729	7.5937	13.865	22.885
9/16	.01483	.31789	1.4022	3.7678	7.9146	14.343	23.552
⅝	.02034	.35758	1.5073	3.9696	8.2443	14.832	24.231
11/16	.02708	.40046	1.6176	4.1784	8.5831	15.331	24.924
¾	.03516	.44662	1.7331	4.3945	8.9310	15.842	25.629
13/16	.04470	.49620	1.8539	4.6179	9.2882	16.365	26.347
⅞	.05583	.54932	1.9803	4,8488	9.6548	16.898	27.079
15/16	.06866	.60610	2.1123	5.0872	10.031	17.443	27.825

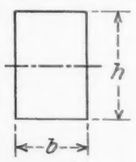
	7	8	9	10	11	12	13
0	28.583	42.667	60.750	83.333	110.92	144.00	182.08
1/16	29.356	43.674	62.024	84.906	112.82	146.26	185.74
⅛	30.142	44.698	63.316	86.498	114.74	148.55	188.42
3/16	30.942	45.738	64 627	88.109	116.69	150.86	191.12
¼	31.757	46.793	65.954	89.741	118.65	153.19	193.85
5/16	32.585	47.865	67.300	91.393	120.64	155.54	196.61
⅜	33.428	48.952	68.665	93.064	122.65	157.93	199.39
7/16	34.284	50.056	70.047	94.756	124.68	160.33	202.20
½	35.156	51.177	71.448	96.469	126.74	162.76	205.03
9/16	36.042	52.314	72.867	98.202	128.82	165.21	207.89
⅝	36.944	53.468	74.306	99.955	130.92	167.69	210.78
11/16	37.859	54.639	75.762	101.73	133.04	170.20	213.69
¾	38.790	55.827	77.238	103.52	135.19	172.72	216.63
13/16	39.736	57.032	78.733	105.34	137.35	175.28	219.60
⅞	40.698	58.254	80.247	107.18	139.55	177.85	222.60
15/16	41.674	59.493	81.781	109.04	141.76	180.46	225.62

Multiply the tabular value for the given depth by the given breadth to get the required moment of inertia of any rectangle.

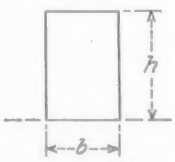
Table II

	14	15	16	17	18	19	20	21	22	23	24	25	26	27
0	228.67	281.25	341.33	409.42	486.00	571.58	666.67	771.75	887.33	1013.9	1152.0	1302.1	1464.7	1640.2
⅛	234.85	288.34	349.40	418.51	496.20	582.94	679.24	785.61	902.54	1030.5	1170.1	1321.7	1485.9	1663.1
¼	241.14	295.55	357.58	427.75	506.53	594.44	691.98	799.64	917.93	1047.3	1188.4	1341.5	1507.3	1686.2
⅜	247.54	302.88	365.90	437.11	517.01	606.10	704.87	813.84	933.49	1064.3	1206.8	1361.6	1529.0	1709.5
½	254.05	310.32	374.34	446.61	527.64	617.91	717.93	828.20	949.22	1081.5	1225.5	1381.8	1550.8	1733.1
⅝	260.68	317.89	382.92	456.25	538.40	629.87	731.14	842.73	965.13	1098.8	1244.4	1402.2	1572.9	1756.8
¾	267.42	325.58	391.62	466.03	549.32	641.98	744.51	857.43	981.21	1116.4	1263.4	1422.8	1595.1	1780.8
⅞	274.28	333 40	400.45	475.95	560.38	654.24	758.05	872.30	997.48	1134.1	1282.6	1443.6	1617.6	1804.9

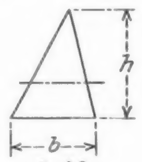
	28	29	30	31	32	33	34	35	36	37	38	39	40	41
0	1829.3	2032.4	2250.0	2482.6	2730.7	2994.7	3275.3	3572.9	3888 0	4221.1	4572.7	4943.2	5333.3	5743.4
⅛	1853.9	2058.8	2278.2	2512.7	2762.8	3028.9	3311.6	3611.3	3928.6	4264.0	4617.9	4990.9	5383.5	5796.1
¼	1878.8	2085.4	2306.7	2543.1	2795.2	3063.3	3348.1	3650.0	3969.6	4307.2	4663.5	5038.9	5434.0	5849.1
⅜	1903.8	2112.3	2335.4	2573.8	2827.8	3098.0	3384.9	3689.0	4010.8	4350.7	4709.4	5087.2	5484.7	5902.5
½	1929.1	2139.4	2364.4	2604.7	2860.7	3132.9	3422.0	3728.2	4052.3	4394.5	4755.6	5135.8	5535.8	5956.1
⅝	1954.6	2166.7	2393.6	2635.8	2893.8	3168.1	3459.3	3767.8	4094.0	4438.6	4802.0	5184.7	5587.3	6010.1
¾	1980.3	2194.2	2423.0	2667.2	2927.2	3203.6	3496.9	3807.6	4136.1	4483.0	4848.8	5234.0	5639.0	6064.4
⅞	2006.2	2222.0	2452.7	2698.8	2960.8	3239.3	3534.8	3847.6	4178.4	4527.7	4895.9	5283.5	5691.0	6119.0



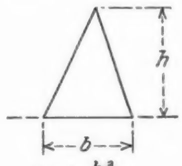
$I = b \cdot \frac{h^3}{12}$



$I = 4b \cdot \frac{h^3}{12}$



$I = \frac{b}{3} \cdot \frac{h^3}{12}$



$I = b \cdot \frac{h^3}{12}$

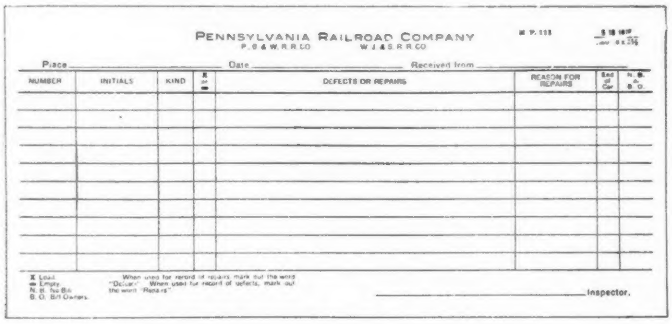
FOREIGN CAR REPAIRS AND BILLING

A Comprehensive System Which Has Been Developed for Effectively Carrying Out This Work

BY E. S. WAY

General Foreman, M. C. B. Clearing House, Pennsylvania Railroad, Altoona, Pa.

With the extension and growth of railway transportation facilities, it became necessary to perfect a system whereby the interchange of freight cars between railroads would be possible regardless of the ownership of equipment, and at the same time the car owner would be protected against unusual damage to his equipment; also so that the car owner would reimburse the handling line for repairs made, due to ordinary wear and tear. This was accomplished by the formulating of a code of rules by the Master Car Builders' Association, governing the interchanging of and repairs to freight cars, which rules also classified defects or damage,



PENNSYLVANIA RAILROAD COMPANY
P. B. & W. R. R. CO. W. J. & S. R. R. CO.

M. P. 113

Place ____ Date ____ Received from ____

NUMBER	INITIALS	KIND	L or E	DEFECTS OR REPAIRS	REASON FOR REPAIRS	End of Car	N. B. or B. O.

L Load. E Empty. N. B. No Bill. B. O. Bill Owners.

When used for record of repairs mark out the word "Defects." When used for record of defects, mark out the word "Repairs."

____ Inspector.

Fig. 1—Car Inspector's Record Blank

as between owner and handling line's responsibility. Up to within a comparatively few years these rules, although making possible the interchange of cars, operated adversely to the prompt movement of traffic at junction points, due to the receiving line being permitted to reject both loaded and empty cars when they were defective. This condition was further aggravated on account of the handling or delivering line being held responsible for numerous defects.

The present rules of interchange, which are the outcome of revisions from year to year, to be consistent with changing conditions, are so broad and liberal that freight cars can now move practically unrestricted over the country and today the car owner is, with a few exceptions that are specifically provided for in the rules, responsible for all repairs that are not due to wreck or derailment; in fact, a foreign car cannot be sent home for repairs unless the road having the car in its possession has direct connection with the owning road. Therefore, the repairing of freight equipment cars while away from the home road has necessarily developed into one of the most important of the many phases of railroad work.

If you will consider for a moment that approximately $182,000,000 is expended annually by the railroads of the United States for repairs to freight cars and that conservatively estimated, 20 per cent of this amount, or $36,000,000, involves repairs to cars on foreign roads, and consider also that this enormous sum of money is exchanged between railroads without any definite means of checking against the work performed by repairing lines, it will be realized that the repairing of foreign cars and billing for the repairs occupies a unique position in business, for the reason that there is, perhaps, no other line of business where such large sums of money are exchanged merely on the basis of common honesty. With approximately 2,000,000 freight cars moving freely over the country subject to repairs first by one road and then by another, it will also be readily appreciated that in order to protect the car owner, and that the principles upon which this important branch of railroad work are founded, may be safeguarded, two things are necessary: First, adequate supervision; and, second, a thorough and efficient system of preparing original records and compiling charges from such records.

The question of supervision is one that cannot be taken up in detail in this paper, as such details are affected to a great extent by local conditions; but there are several points in this connection which, in my opinion, are worthy of consideration. Shop supervision, insofar as it relates to M. C. B. work, need not ordinarily cause much concern, for the reason that the majority of the shops have well-organized forces, particularly where the work is handled on a piecework basis. This is not true of the work performed in transportation yards, for the reason that the work of individual inspectors or repairmen cannot be personally super-

M. P. 124

PENNSYLVANIA RAILROAD COMPANY.

PHILADELPHIA, BALTIMORE & WASHINGTON RAILROAD COMPANY
NORTHERN CENTRAL RAILWAY COMPANY
WEST JERSEY & SEASHORE RAILROAD COMPANY

REPAIR CARD NO. ____

____ 191__

To ____ Gang Leader

Car No. ____ Initials ____ Kind ____

Commenced ____ Completed ____

Light Weight ____ lbs. Size of Axles ____

Charge to ____

No. of Pieces	KIND OF MATERIAL	Weight or Quantity	Price per Unit	Credit

SEAL REPORT and DAMAGED LADING.

____ Foreman.

When Completed, Card must be promptly sent to SHOP CLERK.

Fig. 2—Repair Card

vised by the foreman. Therefore, the possibilities for erroneous charges originating in yards are much greater than is the case with charges originating on regular shop tracks.

On account of repairs made in yards representing, individually, very small amounts, it may not occur to some that this branch of the work warrants special attention; but, as previously stated, as it is impossible for the foreman to personally supervise the repairs to each individual car, and the necessity, therefore arises of depending upon each workman to make proper returns, in addition to the fact that these charges in the aggregate involve considerable sums of money, it is imperative that a clearly defined system be established for checking up this work. This can be accomplished by

*A paper read before the Railway Club of Pittsburgh, March 24, 1916.

delegating competent men to make periodical checks of the work performed by each inspector or repairman at all yard repair points. These investigations should be in the nature of a surprise check in order to realize the best results.

Another feature in connection with the supervision of repairs to foreign cars which may be productive of splendid results if handled along the proper lines, is the centralizing of M. C. B. billing work at one point on a system. Where the centralization idea is carried out and the billing repair cards from all points on the system are forwarded to one central office, a great deal of valuable information reflecting the condition as well as the practices at the various repair points, can be obtained by carefully analyzing the character of the charges, the reasons shown for making the repairs, etc. In other words, where this system is in effect the billing repair cards covering the charges against two or three roads, selecting different roads each month, should be sorted out by stations before the bill is rendered. This will permit of a careful comparison of the work performed at the various repair points and will readily disclose a tendency on the part of one point toward specializing on certain items of repairs, the use of stereotyped terms in designating reasons for repairs, etc. Where such tendencies are apparent, an immediate investigation can be made with a view to determining whether or not there is any special reason for such conditions existing, and, if necessary, corrective measures can be applied. Briefly, the plan outlined will enable those in charge of the M. C. B. work to keep in close touch with the conditions that obtain over the entire road. It is, of course, the general practice of roads to analyze the bills rendered against them somewhat along the plan as outlined above, and, while this is necessary, it is equally as important, and in fact the duty of every road, to make a similar study of their own charges.

Of equal importance to the question of providing for adequate supervision, is that of providing for suitable original records, for the reason that upon the correctness of the original record depends largely the correctness of the billing repair card. This card is the basis for the exchange, monthly, of large sums of money between the railroads of the country, and in an endeavor to bring out what may be

REPAIRS REQUIRED.

________________ 101

________________ Inspector.

Renew	Remove & Replace	Partly R. & R.	Frame	Cause of Damage	Class of Car ______ Cap'y of Car ______	Dolls.	Cents	Mills

Fig. 3—Reverse Side of Repair Card Shown in Fig. 2

considered some of the most essential points that should be covered by original records, the forms that are used in yards, as well as on shop and repair tracks on the Pennsylvania Railroad, have been incorporated in this paper.

Original records may be divided into two general classes: Yard Inpector's or Repairman's Record and Shop or Repair Track Record.

On account of the conditions previously outlined under which repairs are made to foreign cars in yards, it is apparent that special consideration should be given to providing a suitable record blank for this work. This blank should be so designed that the repairman, when he has filled in the information called for, will have a record that will show all the information necessary for the preparation of the billing repair card.

It may be interesting to consider for a moment the car inspector's record blank, shown in Fig. 1. This form has been adapted not only to a record of repairs, but also shopping records, interchange records, and in fact any inspection record which an inspector may be called upon to make. As the note at the bottom of the blank explains, the word "Defects" shown at the top of the center column, is marked out when it is used as a record of repairs; likewise, the word "Repairs" is marked out when the blank is used as a record of defects. A space is also provided for showing the reason for making repairs, and the detailed instructions which govern the use of this form emphasize the importance of showing in the space referred to the *actual reasons for* making the repairs; in other words, the practice of using stereotyped terms is positively prohibited and no report covering repairs is acceptable unless the reason for making them are shown.

Attention is particularly drawn to the extreme right-hand

M. P. 210 A

PENNSYLVANIA RAILROAD COMPANY

Philadelphia, Baltimore & Washington Railroad Company

West Jersey and Seashore Railroad Company

Report of change of Wheels and Axles at ________ Date ________ 191_

Initial ______ No. ______ Kind ______ Capacity ______ Max Wt. ______ Limit Weight I ______ Limit Weight II ______

WHEELS AND AXLE REMOVED

MAKER	Ry. Co.'s Initials	Wheel No.	Date Cast	Kind	Size	Cause of Removal	Service Metal Before Turning	Service Metal After Turning

AXLE	Size of Journal	Diam. of Wheels Fit	Diam. of Center	Cause of Removal	Are Wheels Guaranteed?

WHEELS AND AXLE APPLIED

MAKER	Ry. Co.'s Initials	Wheel No	Date Cast	New or 2d-Hand	Kind	Size	Service Metal

AXLE	Size of Journal	New or 2d-Hand	Location	

Loaded or Empty ______

____________ Inspector

Fig. 4—Shop Record of Wheels and Axles Changed

column under the heading "N. B. or B. O." The letters "N. B." stand for the words "No bill," while the letters "B. O." represent the words "Bill owners." This column may not, at first thought, appeal to many as being very important; yet it was incorporated in this form in order to carry out the idea of having a record from which the billing repair card can be prepared without any assumption whatever on the part of the person making up the billing repair card, as to whether or not any item of repairs is chargeable to car owners. For example, an inspector or yard repairman might have occasion to replace roofing boards that had been damaged on account of being cornered or raked, and if he was not required to specify whether these repairs should be considered "No bill" or "Chargeable to car owners," he might merely show on his record that the boards were broken and in the absence of any other information the repairs may be charged against the car owner. It is well known that inspectors not engaged in interchange inspection, or, in other words, those that handle ordinary train inspection or repairs, in many instances do not attempt to familiarize themselves with the M. C. B. rules insofar as differentiating between handling line's and owner's defects; and, therefore, they may fail to show the necessary information on their records that will enable the person preparing the billing repair card to make proper disposition of the charge. Therefore, by requiring each inspector or repairman to determine the responsibility and indicate it by proper designating marks on their records, they are compelled to study the rules and will naturally develop into more efficient inspectors, and the records will be more reliable.

Another requirement in connection with the use of this form is that each repairman must make his own record of the repairs he makes and his personal signature must appear in the space provided for it. This requirement is considered

very important and, in fact, necessary in order to obtain a reliable record, for the reason that it eliminates the undesirable practice that is frequently followed where one man is permitted or required to take the records for several men working in the same gang. Where the latter practice obtains, there is a possibility that the man held responsible for keeping this record will take a record covering certain items of repairs before the repairs are actually made, with the result that if, for any reason, the repairman fails to make the repairs, an improper charge is rendered against the car owner. Another advantage in connection with requiring each man to take his own record, is that he can be held individually responsible not only for the repairs, but also for the record.

The detailed requirements as just outlined are absolutely essential to a complete and correct record; and when proper consideration is given to the fact that the original record of repairs made is the basis for a charge against the car owner, too much importance cannot be attached to the question of providing suitable forms. This particular blank is gotten out in books of one hundred, and the blanks covering an inspector's records for a day are removed from the book and turned into the office at the close of the day. It thus has an advantage over a book record, for the reason that where a book record is used, the inspector must necessarily carry the book until it is entirely filled, with the result that it may become lost, and as is frequently the case, some of the records become blurred and illegible. Further, this blank is convenient for filing, as it can be filed either with the repair cards covering the repairs enumerated on the individual blank, or it can be filed separately, keeping each day's records together, either of which methods permits of ready reference.

M. P. 208 — 6-1-1914 8x5¾

THE PENNSYLVANIA RAILROAD COMPANY

N. C. RY. — P., B. & W. R. R. — W. J. & S. R. R.

REPORT OF WORK PERFORMED (MATERIAL AND LABOR) AT TEST RACK, ON TRIPLE VALVES, REMOVED FROM FOREIGN CARS

Initials ______ *Car Number* ______ *Date* ______

Repairman ______ *Shop* ______ *Make and Type* ______

Initials of Road and Date of Last Previous Cleaning ______

Why sent to Test Rack ______

Slide Valve Spring ______ *Emergency Valve Piston* ______

Graduating Valve Spring ______ *Check Case* ______

Graduating Valve Stem ______ *Check Case Gasket* ______

Cylinder Cap Gasket ______ *Check Valve* ______

Emergency Valve ______ *Check Valve Spring* ______

Emergency Valve Brass Seat ______ *Bolts and Nuts* ______

Emergency Valve Rubber Seat ______ *Studs* ______

Repairs could not be made at Test Rack, sent to ______ *Shop,*

Date ______ *191 , for* ______ *Repairs.*

______ *Test Rackman.*

Fig. 5—Record of Triple Valve Repairs

Shop or repair track records are to a certain extent governed by the requirements of the various roads, and while there are not the same possibilities for improper records on shop or repair tracks as there are in C. T. yards, the fact that the former embraces more extensive, as well as a varied class of repairs, makes it necessary that a thorough system for keeping records of this branch of the work be provided.

Fig. 2 shows one side of our repair card on which is recorded each operation performed, the reasons for making the repairs and the price paid the workman for the operation. The same instructions obtain with reference to using the actual reasons for making the repairs on this form as were previously outlined in connection with the car inspector's record blank. All the information shown on this form is filled in by the piece-work inspector, who outlines the work to be performed, and who also checks the work after it is completed; and the piece-work inspector is held personally responsible for showing the correct reasons for making the repairs, as well as the operations which were performed.

Fig. 3 shows the opposite side of this shop repair card, the particular feature of which is that the piece-work inspector, or, in some instances, the gang leader, is required to enumerate thereon all material used in connection with the operations that are shown on the reverse side of the card. The advantage of this method is obvious as the person preparing the billing repair card does not have to draw his own conclusion by referring to the labor operations in order to determine definitely the amount, kind or size, of material used; in other words, the person who is in the best position to know the actual operations performed, as well as the material used, namely, the piece-work inspector or gang leader, is held responsible for completing this record, and therefore responsible for the charge thus made against the car owner. An additional requirement in connection with completing this report is that the piece-work inspector is required to show whether the items of labor, as well as the items of material, are chargeable to the car owner. This is accomplished by separating the chargeable items from those that are not chargeable, the former being shown under the caption "Bill owners," and the latter under the caption "No bill." Thus we have a complete record from which a billing repair card can be prepared without any question as to the proper disposition of each item of repairs.

The next record to which attention is directed is shown in Fig. 4, which is a shop record of the change of wheels and axles. It will be understood that the shop repair card Fig. 2 merely covers the labor operation for the exchange of wheels, the reasons for repairs and the kind and amount of material used; whereas, the form shown in Fig. 4 supplements the repair card by showing all of the detailed information that is necessary for preparing the wheel and axle billing repair card. This record is prepared either by the piece-work inspector in direct charge of the repairs, or by a special man who is detailed to check up the condition of the wheels and axles removed, as well as those applied; except that the amount of service metal before and after turning on wrought steel wheels is determined at the wheel shop when the wheels are turned. This part of the information is obtained by a report being forwarded to the foreman of the wheel shop covering each pair of wrought steel wheels removed, the wheels also being properly tagged for identification. When the wheels arrive at the wheel shop the amount of service

M. P. 8 — 274 C 5-8-13 5 x 10½

PENNSYLVANIA RAILROAD COMPANY

PHILADELPHIA, BALTIMORE & WASHINGTON RAILROAD COMPANY
NORTHERN CENTRAL RAILWAY COMPANY
WEST JERSEY & SEASHORE RAILROAD COMPANY

______ Westinghouse—New York Type Triple Valve Removed

______ 191___ From ______ Car Number

at ______ Shop

Date and Initial last Cleaned and Oiled ______

______ Foreman.

ABOVE TO BE FILLED BY SHOP REMOVING VALVE

	REPAIRS MADE	WHY MADE
Triple Valve Body		
Cylinder Bushing		
" " Cap		
" " Gasket		
Side "		
Front "		
" " Gasket		
Side Cap		
Cap Screw		
Half Inch Plug		
Exhaust Outlet Plug		

Repaired ______ 191___

To be sealed in check case.

______ Foreman.

Fig. 6—Another Form Used in Connection with Triple Valve Repairs

metal is carefully measured before turning and again after turning, and the measurements thus taken are promptly reported to the foreman under whose jurisdiction the wheels are removed. The latter then inserts this information on the wheel and axle report and the wheel shop report is attached to the wheel record as a part of the permanent file. However, before filing, the billing repair card is prepared from the information shown on both the wheel report, Fig. 4, and shop repair card, Fig. 2.

The question of providing suitable forms for keeping record of triple valve repairs is an important one and therefore merits a few moments consideration. Fig. 5 is a facsimile of our form M. P. 298, which is intended to take care of repairs made to triple valves at test racks. The information called for on the upper portion of the form is filled in by the repairman who removes the triple valve from the car. The form is then inserted in the check valve case and the triple valve, after being either tagged or marked so that it can be readily identified at the test rack as a foreign triple valve, is sent to the test rack, where it is given preference over triple valves removed from system cars in order not to incur any unnecessary delay in preparing the billing repair card. The test rack man removes the form from the valve, and in cases where the repairs needed are of such a nature that they can be performed at the test rack, he indicates just what repairs are made, as well as the reasons for making them, on the blank line opposite the items that are involved. The form is then signed by the man in charge of the test rack and forwarded to the foreman under whose jurisdiction the triple valve was removed. The foreman, in the meantime, is holding the shop repair card, Fig. 2, which covers the work performed at the car, and upon receipt of the test rack report he has all the necessary information to complete the billing repair card.

M. P. 399

THE PENNSYLVANIA RAILROAD COMPANY

P., B. & W. R. R. W. J. & S. R. R.

Altoona, Pa., ______ 191__

Mr. ______

Dear Sir: ______

Please refer to attached Repair Card showing repairs made to ______

car No. ______ at ______ date ______ 191__, and furnish information asked for below.

RETURN THIS FORM WITH CORRECTED CARD AND YOUR EXPLANATION SHOWN BELOW

Yours truly,

J. T. WALLIS,

General Supt. Motive Power.

Fig. 7—Form for Securing Additional Information

There are many triple valves, of course, which require repairs that are not ordinarily made at a test rack located adjacent to repair tracks. When the test rack man finds a valve that he cannot repair, he shows on the bottom of Fig. 5 the shop to which the valve is to be sent for repairs, the date, and the principal defect that necessitates sending the valve to the machine shop. After placing his signature on this form, it is forwarded immediately to the foreman under whose jurisdiction the valve was removed. The latter then prepares a billing repair card covering the test rack repairs, as well as the repairs made at the car, as shown on the shop repair card, Fig. 2, or the yard report, Fig. 1. This billing repair card is marked with the notation "Bill for repairs to follow." In order that the additional repairs to the triple valve may be obtained, the test rack foreman, before forwarding his report, Fig. 5, to the shop foreman, fills in the information called for at the top of from M. P. 8 Fig. 6. This form is inserted in the check valve case and the triple valves forwarded to the designated shop. After the repairs have been completed, the items of repairs, as well as the reasons for making them, are filled in on Fig. 6, which is then sent to the foreman holding the original record, Fig. 2 or Fig. 1, for his information in preparing the billing repair card for the additional repairs. In each case the original record, Fig. 2 or Fig. 1, is filed with the test rack report, Fig. 5, and the machine shop report, Fig. 6, when the latter is used. Thus we have a complete record of the entire transaction. It might be well to state in this connection that each form illustrated is supplemented by printed detailed instructions. Likewise, the entire subject of handling repairs to foreign cars and the preparation of charges for them is outlined by printed instructions. The particular advantage in issuing printed instructions is that every detail of the subject is presented to each individual employee who has to do with the handling of this work, without any possibility of the meaning or intent of the instructions being obscured by change of language or errors in transcribing, which conditions frequently obtain where instructions are issued through the usual channels by letter. Further, the printed instructions can be more readily filed for convenient reference.

After a complete and adequate system of original records has been provided for, as well as explicit instructions concerning their use, there is one more step that must be taken to insure correct charges, viz.: to institute frequent checks both of the work being performed and the records at all repair points, in order to see that every detail of the instructions is being fully complied with. Such checks are absolutely essential for the reason that no matter how efficient a system of records may be, or how explicit are the instructions, the results desired cannot be obtained if the supervision is neglected.

The most important, or rather the essential features that should be covered by the original records, may be summed up briefly, as follows:

1. Yard records should not be made until after the repairs have been completed and should be prepared and signed by the person performing the work.
2. Shop or repair track records should be checked against the repairs made after the work has been completed.
3. All material used in connection with labor performed should be itemized on shop or repair track records, care being exercised to show the proper description of the material, as required by the M. C. B. rules.
4. All items of both labor and material that are properly chargeable to car owners under the rules should be separated from the items that are not chargeable to car owners and a suitable designating mark or phrase used to show responsibility.
5. The actual reasons for making the repairs should also be shown on the original records and the use of stereotyped terms prohibited.

After disposing of the question of original records, the preparation of the M. C. B. building repair cards is a comparatively simple matter. However, there are a number of points in connection with this phase of the work which cannot be overlooked, the most important of which, without doubt, is to see that the information on the billing repair card coincides in every detail with that shown on the original record; and further, the man preparing the billing repair card should not be permitted to draw his own conclusions as to labor performed, amount and kind of material used, or reasons for making the repairs. In other words, if and details of these essential points are not clearly shown on the original record, the latter should be returned to the man preparing it for correction. If this plan is closely adhered to, a great many of the troubles experienced in connection with M. C. B. billing will be eliminated.

After the items of labor and material have been entered upon the billing repair card, the next step to consider is the details of the charges, viz.: weights, quantity and value of material, and labor allowances. It is the practice of some roads to enter these details on the billing repair card at cen-

tral or division offices; but the practice that is followed on the Pennsylvania Railroad of completing every detail of the charge in the office of the foreman under whose direct charge the repairs are made, has many advantages which may be summarized, as follows:

1—The shop people, by being required to complete all details of the charges, must necessarily become close students of the M. C. B. rules with reference to responsibility for repairs, and particularly with the prices for labor and material, and where the men preparing the billing repair cars do not have this knowledge, the card frequently is not intelligently prepared, with the result that it is difficult to determine what the proper material or labor charges should be.

2—Where the billing repair card is completed in all details in the shop where the work is performed, the record repair card necessarily shows all this information, and exact duplicates of the original can be obtained at any time.

3—This method results in the training of an efficient corps of M. C. B. clerks over the entire system, from which vacancies in the general office, where expert M. C. B. men are necessary, can at all times be filled.

4—The handling of the billing at the general office is greatly facilitated, as the necessity for returning the cards to the shop for additional information or correction is minimized.

In order to effectively carry out the idea of completing the billing repair card at the shop, it is necessary that the billing repair cards be forwarded daily, direct to the central office where they should be immediately and carefully checked. Any errors that are detected or additional information that may be required should be handled direct with the foreman whose name appears on the billing repair card, instead of such communications following the regular channel, as is provided for by the organization of the road. The advantage of this is obvious, for the reason that, in addition to getting quick results, a great deal of unnecessary work in the office of the superintendent of motive power, master mechanic or general foreman, is eliminated.

A convenient and efficient method of communicating with the shop foreman is by the use of a form similar to that shown in Fig. 7. The clerk who finds an error or insufficient information on a billing repair card indicates, in the space provided, the information desired. This form is filled out in duplicate, the original attached to the billing repair card which is to be returned and the carbon copy held, by the clerk who checks the charge, until a reply is received. It is advisable in the majority of cases to return the billing repair card to the shop for correction where it would necessitate an erasure of certain information, if the correction were to be made in the central office. However, in cases where it is not objectionable to make a correction on the billing repair card before the bill is rendered, the correction may be made at the central office, but the shop should be advised of the correction made by the use of the form referred to, so that they can correct their record repair card and be in a position to avoid similar errors in the future.

A very important factor that contributes greatly to the rapid and accurate checking of charges on the billing repair card is that of itemizing on the extreme right-hand margin the labor allowances for each item of labor appearing on the repair card, instead of merely showing the total hours labor on the card. This not only facilitates the work in the central office of the billing road, but also enables the car owner to readily see how the total labor charge has been determined, and consequently materially assists in minimizing correspondence between the car owners and the road rendering bill.

There are, of course, other details in connection with this subject that could be commented upon, but those already covered will present the essential points that may be considered necessary to obtain an efficient and reliable system for handling foreign car repairs and the preparation of charges for the work performed.

DESIGN OF PASSENGER EQUIPMENT

BY VICTOR W. ZILEN
Associate, American Society of Mechanical Engineers

IV

BRAKE SHOE SUSPENSION

In keeping pace with the increasing weight of cars, brake shoe loads have reached a point to exceed which results in the melting of the brake shoe metal. In what follows it is the purpose of the writer to show how a destructive pressure may be brought against a portion of the surface of the brake shoe when the total load is well within the capacity of the shoe if properly distributed by a correct suspension of the brake head.

In Fig. 5 *K-M* represents a four-wheel truck with inside hung brake shoes suspended from a point above the center line of brake head; *L-N* shows the brake shoes suspended from a point below the center of brake head.

Let P = brake shoe load, normal to the wheel
V = frictional force between shoe and wheel, having for its reaction R at E
A and B = reactions of the brake shoe load P
A_1 and B_1 = reactions of the pressure produced by the force V, which tends to crowd the shoe against the wheel by turning it about the point E; the intensity of this pressure is evidently $\frac{Vb}{c}$
A_t and B_t = total brake shoe pressure at top and bottom respectively
f = coefficient of brake shoe friction.
$V = fP$

Taking moments about D (Fig. 5 K) we have for the algebraic sum

$$Pd+Va+Ah-Bg = O, \text{ or } B = \frac{Va+Pd+Ah}{g}$$

and for equilibrium of translation

$$B = P-A$$

By substituting for V its value, fP and transposing the following values are found:

$$A = \frac{P(g-d-fa)}{h+g} \quad \ldots\ldots (50)$$

$$B = P\frac{(h+d+fa)}{h+g} \quad \ldots\ldots (51)$$

Taking moments about E, we have

$$A_1(c-h)+B_1(c+g)-Vb = O. \text{ or } B_1 = \frac{Vb-A_t(c-h)}{c+g}$$

and for equilibrium of translation

$$\frac{Vb}{c}-(A_1+B_1) = O, \text{ or } B_1 = \frac{Vb}{c}-A_1$$

Solving these equations and substituting for V, its value, fP the following equations are obtained:

$$A_1 = \frac{fPbh}{c(h+g)} \quad \ldots\ldots (52)$$

$$B_1 = \frac{fPbh}{c(h+g)} \quad \ldots\ldots (53)$$

Then the total pressure at the top and bottom of the brake shoe will be respectively

$$A_t = \frac{P}{h+g}\left(g-d-fa+\frac{fbg}{c}\right) \quad \ldots\ldots (54)$$

$$B_t = \frac{P}{h+g}\left(h-d+fa+\frac{fbh}{c}\right) \quad \ldots\ldots (55)$$

By the same process it will be found that the values of A_1 and B_1 in Fig. 5 L are the same as those shown in equations (52) and (53), while the values of A and B are:

$$A = \frac{P(g+d-fa)}{h+g} \quad \ldots\ldots (56)$$

$$B = \frac{P(h-d+fa)}{h+g} \quad \ldots\ldots (57)$$

The values for the total pressure at the top and bottom of the

brake shoe respectively will be found to be as follows:

$$A_t = \frac{P}{h+g}\left(g+d-fa+\frac{fbg}{c}\right) \quad\text{.....................(58)}$$

$$B_t = \frac{P}{h+g}\left(h-d+fa+\frac{fbh}{c}\right) \quad\text{.....................(59)}$$

Referring to Fig. 5 *M*, it will be seen that the direction of action of *V* is opposite to that shown in Fig. 5 *K*. In this case the brake shoe pressure values are:

$$A = \frac{P\,(g+fa-d)}{h+g} \quad\text{...............................(60)}$$

$$B = \frac{P\,(h+d-fa)}{h+g} \quad\text{...............................(61)}$$

$$A_1 = -\frac{fPbg}{c\,(h+g)} \quad\text{...............................(62)}$$

$$B_1 = -\frac{fPbh}{c\,(h+g)} \quad\text{...............................(63)}$$

$$A_t = \frac{P}{h+g}\left(g-d+fa-\frac{fbg}{c}\right) \quad\text{.....................(64)}$$

$$B_t = \frac{P}{h+g}\left(h+d-fa-\frac{fbh}{c}\right) \quad\text{.....................(65)}$$

In Fig. 5 *N* the values of A_1 and B_1 will be identical with those given for Fig. 5 *M*, while the others will be:

$$A = \frac{P\,(g+d+fa)}{h+g} \quad\text{...............................(66)}$$

$$B = \frac{P\,(h-d-fa)}{h+g} \quad\text{...............................(67)}$$

$$A_t = \frac{P}{h+g}\left(g+d+fa-\frac{fbg}{c}\right) \quad\text{.....................(68)}$$

$$B_t = \frac{P}{h+g}\left(h-d-fa-\frac{fbh}{c}\right) \quad\text{.....................(69)}$$

These formulæ assume that the reactions A_t and B_t are at points near the top and bottom ends of the shoe and results derived by this method will serve as a basis for conclusions as to the relative merits of the various methods of brake shoe suspension. Replacing the various symbols in the formulæ by values in pounds and inches taken from examples in actual service, we may determine what is the effect of differences in suspension. Let

a = 4.5 in.
b = 7 in.
c = 20 in.
d = 4 in.
P = 15,000 lb.
f = .19 mean coefficient of friction (friction of motion). (R. A. Parke; see Railroad Gazette, June 14 and 21, 1901.)

g = 10 in., h = 2 in. } Cases K and M

g = 2 in., h = 10 in. } Cases L and N

Case K, Formulae (54) and (55).

$$A_t = \frac{15{,}000}{10+2}\left(10-4-.19\times4.5+\frac{.19\times10\times7}{20}\right) = 7{,}263 \text{ lb.}$$

$$B_t = \frac{15{,}000}{10+2}\left(2+4+.19\times4.5+\frac{.19\times7\times2}{20}\right) = 8{,}735 \text{ lb.}$$

Difference = 1,475 lb.

Case M, Formulae (64) and (65).

$$A_t = \frac{15{,}000}{10+2}\left(10-4+.19\times4.5-\frac{.19\times7\times10}{20}\right) = 7{,}775 \text{ lb.}$$

$$B_t = \frac{15{,}000}{10+2}\left(2+4-.19\times4.5-\frac{.19\times7\times2}{20}\right) = 6{,}265 \text{ lb.}$$

Difference = 1,510 lb.

Case L, Formulae (58) and (59).

$$A_t = \frac{15{,}000}{10+2}\left(2+4-.19\times4.5+\frac{.19\times7\times2}{20}\right) = 6{,}600 \text{ lb.}$$

$$B_t = \frac{15{,}000}{10+2}\left(10-4+.19\times4.5+\frac{.19\times7\times10}{20}\right) = 9{,}400 \text{ lb.}$$

Difference = 2,800 lb.

Case N, Formulae (68) and (69).

$$A_t = \frac{15{,}000}{10+2}\left(2+4+.19\times4.5-\frac{.19\times7\times2}{20}\right) = 8{,}470 \text{ lb.}$$

$$B_t = \frac{15{,}000}{10+2}\left(10-4-.19\times4.5-\frac{.19\times7\times10}{20}\right) = 5{,}600 \text{ lb.}$$

Difference = 2,840 lb.

It is evident that the suspension as shown at *K-M* is to be preferred over that shown at *L-N* as a more uniform distribution of pressure over the face of the brake shoe is thereby obtained.

One more common method of brake shoe hanging may be considered. This is the suspension of brake head about a point on the center line. Under this condition $h = g = 6$

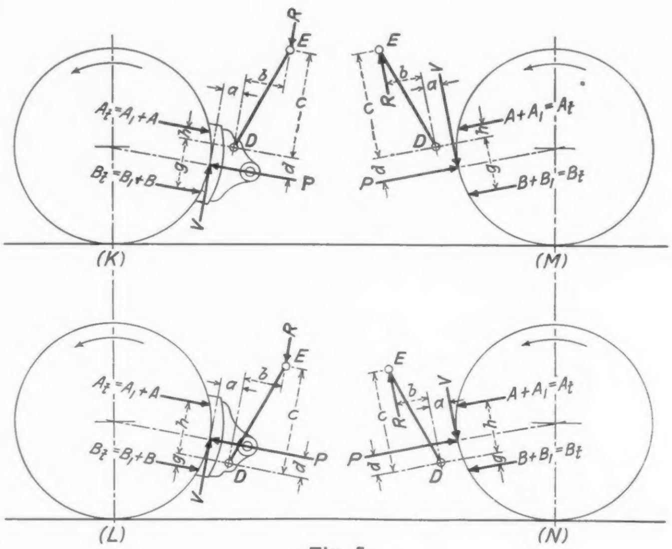


Fig. 5

in., and $d = 0$. The length and angularity of the hanger will be assumed as remaining unchanged. Referring to either formulæ (54) and (55) or (58) and (59) for the leading wheel and substituting numerical values:

$$A_t = \frac{15{,}000}{6+6}\left(6-.19\times4.5+\frac{.19\times7\times6}{20}\right) = 6{,}930 \text{ lb.}$$

$$B_t = \frac{15{,}000}{6+6}\left(6+.19\times4.5+\frac{.19\times7\times6}{20}\right) = 9{,}068 \text{ lb.}$$

In a similar manner, by using either formulæ (64) and (65) or (68) and (69) the values for the rear wheel are found to be:

$$A_t = \frac{15{,}000}{6+6}\left(6+.19\times4.5-\frac{.19\times7\times6}{20}\right) = 8{,}070 \text{ lb.}$$

$$B_t = \frac{15{,}000}{6+6}\left(6-.19\times4.5-\frac{.19\times7\times6}{20}\right) = 5{,}930 \text{ lb.}$$

The large differences in load between the two ends of the shoes make this method of brake shoe suspension undesirable.

The ideal suspension is one in which A_t and B_t are equal for the leading pair of wheels. Equating formulæ (54) and (55) for the leading wheels:

$$\frac{P}{h+g}\left(g-d-fa+\frac{fbg}{c}\right) = \frac{P}{h+g}\left(h+d+fa+\frac{fbh}{c}\right)$$

$$d = (g-h)\left(\frac{fb}{2c}+.5\right)-fa$$

The values of g and h depend upon the value of d. By referring to Fig. 5 *K* it will be seen that the relation is expressed by the equation

$$g-h = 2d \quad\text{.........................(56)}$$

By substituting this value for $g-h$ in the above and reducing it is found that

$$d = \frac{ac}{b} \quad\text{.........................(57)}$$

and on substitution of the numerical values it is found that $d = 12.9$ in. This is beyond the limit to which the point of suspension can be raised above the center line of the brake head with the assumed dimensions and angle of inclination of the brake hanger, but it clearly indicates the desirability of raising the suspension as high as possible, and by proper proportioning of the length and angle of the hangers it would become possible to make the pressure equal at the top and bottom of the shoe.

Only so much of the subject of brakes has been treated

in this article as the writer thought was new. Other information bearing some relation to this is already available.

COMPARISON OF ALL STEEL AND COMPOSITE COACH CONSTRUCTION*

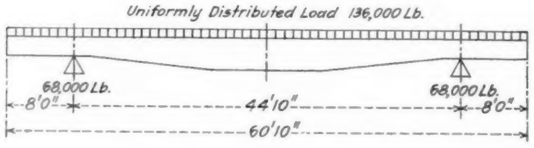
BY K. F. NYSTROM
Chief Draftsman, Car Department, Grand Trunk, Montreal, Que.

"Safety First" is the slogan of the present time. The safety of the working man and of the people at large, is at present considered as never before, and in passenger traffic this is carried to extremes. But the popular opinion regarding safety does not always coincide with the actual facts; for instance, an all-steel car can be of weaker construction than a wooden car. The all-steel car is considered by the traveling public as the only safe steam railway conveyance. Few practical men, however, will deny that the superstructure of a well-built wooden car is as strong as the average superstructure of a modern steel car. But they will admit that the weakness in an all-wood car lies in the underframe, on account of the continual increase in weight of trains.

UNDERFRAME

The underframe, which is the back-bone of the car, must be of sufficient strength to sustain all imposed loads, including those arising from end-shocks. As the stresses produced from end-shocks in a heavy modern passenger train are occasionally extremely high, we have to resort to steel underframe construction. The ultimate strength of wood is too low to sustain the forces imposed. The wooden underframe is, therefore, a thing of the past in car construction.

In studying a number of designs of cars I have found that



Estimated weight of car body	70,000 lb.
Live load	60,000 lb.
Overload, 10 per cent of live load	6,000 lb.
Total load	136,000 lb.
Bending moment = M.B.	
At center of car M.B. max	3,882,000 in. lb.
At bolster M.B. max	860,000 in. lb.

Fig. 1

in many cases it is economical to build the underframe sufficiently strong to carry the entire load, as well as to sustain the end-shocks. If the underframe is of sufficient strength to withstand both the load and the end-shocks the side construction can be much simplified. This is particularly true of mail and baggage cars, as the side posts can be uniformly spaced, thus reducing the amount of detail work.

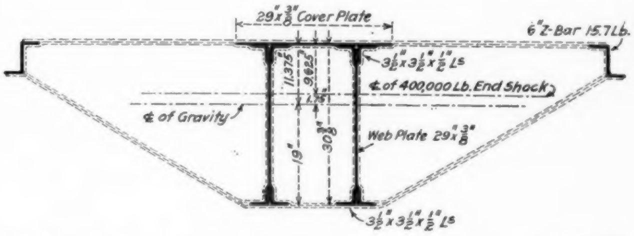
In order to illustrate the requirements of a modern underframe the following example is selected: Figs. 1, 2 and 3 show an underframe for a 60-ft. baggage car, considered as a beam on two supports, these supports being the two trucks. The weight of the car has been assumed as 70,000 lb. for the car body and 60,000 lb. plus 10 per cent for live load, making a total of 136,000 lb. load on this underframe. This produces a bending moment of 5,882,000 in.-lb. at the center of the car and 860,000 in.-lb. at the bolster. The weight of car represented in this example is rather high and the live load is considerably above the actual requirements for a baggage or mail car. The United States post office department specification for a steel full postal car calls for a maximum of 50,000 lb. live load. The bending moment in a 74-ft. passenger coach is less than in the above example. It may, therefore, be assumed that if an underframe is designed to withstand a bending moment of approximately 5,900,000 in.-lb. and an end-shock of 400,000 lb. it will be suitable for all classes of passenger cars.

The stresses imposed upon the underframe from end-shocks must be dealt with separately. The underframe must be treated as a column and both direct and eccentric forces considered. For members in compression the stresses must be reduced in accordance with usual engineering practice. The American Railway Engineering Association has adopted an empirical formula for unit compression stress as follows:

$$16.000-70\frac{L}{R}.$$

This formula has been approved by the United States post office department which allows 20 per cent greater fibre stress than that arrived at by using the above formula.

These requirements for the underframe could easily be satisfied if the car designer could change the construction to suit the conditions, but unfortunately a number of standards are established which the designer cannot change, such as truck height, coupler and buffer heights and the general clearance dimensions of cars. The designer has to compro-



Area of section = A .... 67.805 sq. in.
Distance from top of cover plate to center line of gravity = e_c .... 11.375 in.
Distance from bottom of center sill to center line of gravity = e_t ... 19.00 in.
Center line of 400,000 lb. concentrated end shock = y .... 9.625 in.
Moment of inertia = I .... 9,428 in.[4]

Section modulus for compression $= Z_c = \frac{I}{e_c} = \frac{9,428}{11.375}$ .... 829 in.[3]

Section modulus for tension $= Z_t = \frac{I}{e_t} = \frac{9,428}{19}$ .... 496 in.[3]

Radius of gyration $= R = \sqrt{\frac{I}{A}} = \sqrt{\frac{9428}{67.805}}$ .... 11.8 in.

Allowable fibre stress per sq. in. for 60 ft. baggage car

$$=\left(16,000-70\frac{L}{R}\right)+\left(16,000-70\frac{L}{R}\right)\frac{1}{5} \quad \ldots\ldots 14,076 \text{ lb.}$$

Bending moment produced by load (see Fig. 1) = Mb_1 ..... 5,882,000 in. lb.
Bending moment produced by end shock = Mb_e =
400,000 lb. × 1.75 .... 700,000 in. lb.
Total Mb .... 6,582,000 in. lb.

Maximum tension at center of car $= S_t = \frac{Mb_1}{Z_t} = \frac{5,882,000}{496}$ ..... 11,860 lb.

Maximum compression at center of car = S_c

$$= \frac{Mb_1 + Mb_e}{Z_c} + \frac{400,000}{A} \quad \ldots\ldots 13,840 \text{ lb.}$$

Fig. 2—Section Through Underframe at the Center

mise and be satisfied with a design which as closely as possible comes up to an ideal construction when considered from an engineering standpoint.

The sections shown in Figs. 2 and 3 satisfy the requirements for a modern underframe in relation to load and end-shocks. It will be observed that the extreme fibre stresses come well below the limits required by the United States post office department specification for all steel full mail cars, which is used as a foundation for all passenger car designs today.

The underframe considered in this example is probably not the most economical construction for all designs, but I have endeavored to give due attention to the construction from a maintenance standpoint, and have not employed any section with less thickness than 3/8 in. in order to provide ample bearing surface for all rivets and to give a reasonable allowance for deterioration. An attempt has been made to

*Abstract of a paper read at the February, 1916, meeting of the Canadian Railway Club.

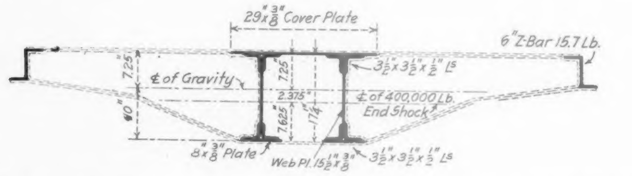
reduce the number of different sizes of material. All angles employed are of one size and all plates are 3/8 in. thick, so that the majority of details required can be obtained from the scrap cut from center sills.

The object, however, is not to produce an ideal design, but to show what a complex problem the car designer has to contend with.

BODY FRAMING

It is necessary to have a substantial end frame to prevent telescoping, particularly if an efficient anti-telescoping device is not employed. End framing built in accordance with United States post office department specifications, which call for a section modulus for vertical end members of not less than 65 of which 75 per cent must be concentrated in the door posts and posts adjacent to door posts, offers a very good construction which is amply strong.

To prove that the superstructure of a wooden car may be equally as strong as that of a steel car, I will compare the side posts in wood and steel cars. Fig. 4 shows a standard section of a wood post and Fig. 5, a typical design of a post for steel cars. For comparison consider the ultimate strength of ash to be 12,000 lb. per sq. in. and of steel 60,000 lb. per sq. in.; in other words, the steel to be five times as strong as ash when subject to bending. The United States post office department specification for the construction of steel full postal cars requires that "the sum of the section moduli taken



Area of section = A .... 63.68 sq. in.
Distance from top of cover plate to center line of gravity = e_c ..... 7.25 in.
Distance from bottom of center sill to center line of gravity = e_t ... 10.00 in.
Center line of 400,000 lb. concentrated end shock = y .... 9.625 in.
Moment of inertia = I .... 3,013 in.[4]

Section modulus for compression $= Z_c = \frac{I}{e_c} = \frac{3{,}013}{10}$ .... 301 in.[3]

Section modulus for tension $= Z_t = \frac{I}{e_t} = \frac{3{,}013}{7.25}$ .... 416 in.[3]

Allowable fibre stress per sq. in. for 60 ft. baggage car at bolster .. 15,000 lb.
Bending moment produced by load (see Fig. 1) = Mb_1 ...... 860,000 in. lb.
Bending moment produced by end shock = 400,000 lb. × 2.375
= Mb_e .... 950,000 in. lb.
Total Mb .... 1,810,000 in. lb.

Maximum tension at bolster $= S_t = \frac{Mb_1}{Z_t} = \frac{860{,}000}{416}$ .... 2,070 lb.

Maximum compression at bolster $= S_c$

$= \frac{Mb_1 + Mb_e}{Z_c} + \frac{400{,}000}{A}$ .... 123.00 lb.

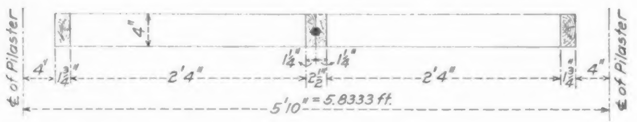
Fig. 3—Section Through Underframe at the Bolster

at any horizontal section between floor line and top line of windows, of all posts and braces on each side of the car, located between end posts, shall not be less than 0.30 multiplied by the distance in feet between the center of end panels, a panel length being considered as the distance between lines ofrivets in adjacent vertical posts."

In other words, the average section moduli on each side of the car for side posts must not be less than 0.30 per running foot. Now consider one section of the side of a standard railway car, now being largely used, the section being from center to center of pilasters which includes lower windows with a gothic above. The length of such a section is, on an average, 5 ft. 10 in. or 5.8333 ft. The number of posts in the 5.8333-ft. section is four for wood cars, two narrow and two wide, and three for steel cars. Referring to Figs. 4 and 5 the comparative section modulus for steel is seen to be 0.5 and for wood 0 55. The wood posts are 10 per cent stronger than the steel posts. Both constructions, however, meet the United States mail service requirements. This comparison shows that the strength of the side of a wooden car—when considered perpendicular to its side, which is vital in case of wreck—is in some instances stronger than a steel car. I wish, however, to make plain that no claim of superiority is made for the side-framing of a wooden car, considered as a carrying member or truss. A combination of wood and steel for side-framing seems to me to be the most practical.

ROOF

No one familiar with car construction and maintenance of cars will deny that the canvas roof, properly laid, gives remarkably good service; in fact, it will outlast the car if given



Section modulus four for ash posts as shown .... 16 in.[3]

Section modulus per running foot $= \frac{16}{5.8333}$ .... 2.74 in.[3]

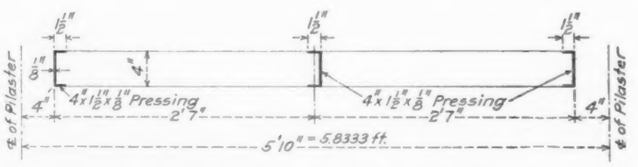
The equivalent section modulus for steel, considering the strength

of ash $\frac{1}{5}$ that of steel $= \frac{2.74}{5}$ .... 0.55 in.[3]

Fig. 4

reasonable care. The steel roof, on the other hand, has not, up to the present time, proved a success. Steel roofs having vertical expansion joints about 1¼ in. in height soon wear out on account of the abrasive action of cinders. The deck screens in an all steel car are objectionable on account of the pockets formed behind the screen in which gases, moisture and cinders collect. These destroy the paint and in a short time serious corrosion takes place, which cannot be detected before a car is sent to the shops for general repairs. A steel car roof must be frequently painted, and it cannot be neglected without serious consequences, as can a canvas roof, if the regular period between shoppings for any reason is prolonged. In connection with the canvas roof it is understood that the wood roof framing is tied together at frequent intervals with steel carlines which should extend in one piece from side plate to side plate, to which they should be firmly secured.

The inside finish in an all-steel car is hard to restore to its



Section modulus of three pressed steel posts = 3 × .98 .... 2.94 in.[3]

Section modulus per running foot $= \frac{2.94}{5.833}$ .... 0.5 in.[3]

Fig. 5

original appearance, in case it must be touched up where the paint has been scratched, worn or peeled off. Wood cars having stained and polished wood finish can easily be restored to their original appearance in case the finish should be damaged.

The features of passenger car construction which, I believe, best meet present requirements, considering first cost, maintenance and the safety and comfort of passengers, may be summed up as follows:

First.—A steel underframe which will take care of all loads, strains and buffing shocks imposed on the car, with an efficient buffer, draft gear and some device which will lock the trucks to the body of the car in case of accident to prevent telescoping or a turn-over of the car.

Second.—A substantial end frame which will stand a very severe buffing shock and prevent telescoping.

Third.—A combination steel and wood side framing and wood exterior finish.

Fourth.—A combination wood and steel roof covered with canvas.

Fifth.—An interior wood finish.

With this construction the railroad can repair its own cars in the old wood-car repair shops, without going to the expense of installing a considerable amount of modern machinery, which would be necessary with all-steel cars. The traveling public will be provided with a car which will compare favorably in strength with an all-steel car. The inside finish can be made more artistic, easier to maintain and simpler to renew when required. In case of wreck the passengers will have a chance to cut their way out from the debris, which is impossible in an all-steel car.

The use of steam from the locomotive for heating passenger cars and lighting by electricity practically eliminate the danger of fire. The all-steel car is probably more nearly fire-proof, but when we consider that upholstering material, varnish and other details are inflammable, this car is comparatively as fire-proof as an all-steel car. The temperature in this car will not be subject to the sudden changes met with in the all-steel car. It will be warmer in winter and cooler in summer, and will not develop the sweating which is so troublesome in all-steel cars.

STEEL BOX CARS ON THE PENNSYLVANIA

"Another Step Toward Making This an All-Steel Railroad," is the title of an article which appeared in a recent number of the Pennsylvania Railroad bulletin, "Information." This little publication is intended for the use of both the employees and the public. While the article is of the semi-popular type, as contrasted with the strictly technical article, it will undoubtedly prove of interest to many of our readers because of the information which it presents covering the extent to which the manufacture of all-steel box cars is carried on by the Pennsylvania and also the statement of policy which it contains as to the use of steel equipment by that system. The article is as follows:

Not many years will pass before the wooden box car will be a thing of the past on this railroad system. The fact is, it will not be long before every train operated by this railroad will be all-steel from one end to the other. One year ago the Pennsylvania Railroad announced that it had added to its equipment the most modern type of freight car in the world—the all-steel box car. To-day it has in operation more than 2,000 of these cars which have replaced wooden ones. Others are being turned out by the railroad shops at Altoona, Pa., at the rate of one every 55 minutes. At the end of 1915 the company had 6,500 steel box cars, representing an investment of about $9,000,000.

The first steel box car cost $1,500 to build. Experience has reduced this cost materially; it is now about $1,300, which is still considerably above the cost of a wooden car, but this railroad believes that steel box cars will, to a large extent, justify their higher first cost by their added durability, greater strength and longer life.

Employees to the number of 705 are engaged in building these steel box cars in the Altoona, Pa., shops.

WHERE THE STEEL BOX CARS ARE BUILT

The building in which the steel box cars are constructed—the company's Altoona steel car shop—covers the space of a large city square and looks as though it had been built to be the mammoth of all convention halls. The visitor's first impression is that he has entered a boiler factory. This is because every car is put together with 5,100 rivets, and every rivet is driven home with a rattle of blows from a pneumatic riveting tool—unquestionably one of the most successful noise-making devices ever invented.

Someone with a taste for figures has calculated that on a busy day the riveting tools in this building strike 1,000,000 impacts upon resounding steel, or 25 to 30 per second throughout the working hours.

A steel box car from the trucks up—that is, the under-

Part of a Day's Output of Steel Cars from the Pennsylvania Steel Car Shop, at Altoona

frame, body and roof—is built practically altogether of riveted steel plates. These plates are first moved by overhead cranes to the shearing machines, of which there are several of different sizes. Suspended in chains, so that they may be swung and turned with the least possible expenditure of human effort, the plates are seized by gangs of men who, combining skill with brawn, guide them between the blades of the shears, where they are cut into the proper shapes. The largest of the shears can make a 10-ft. cut in a quarter-inch steel plate about as easily as a tailor snips three inches from a piece of cloth.

Next the rivet holes are punched. On the longest pieces this is done on the "multiple punch," a wonderful machine which handles four pieces of work at once, and can make as many as 160 holes through a half-inch steel plate on every movement.

After the punching, if the plates are not intended for parts of the car which are perfectly flat—that is, if the edges are to be turned for riveting, or if they are to be bent into the "U" forms used in giving rigidity to the underframe—they next go to the forming presses. These are the most powerful machines in the Altoona shops. The largest of them is capable of exerting nearly 4,000,000 pounds pressure. It folds steel so noiselessly and easily that it is difficult to realize the enormous power that is applied.

Fitting the center sills is the first job in erecting a car. A gang of men, armed with pneumatic riveting tools, fasten the sills together as fast as red-hot rivets can be tossed to them from the forges. Next in order, after the joining of the center sills, is the fitting and riveting of the diaphragms and braces, the application of air-brake equipment and couplers, and riveting the sides and ends. The car is then lifted from the small erecting trucks and lowered on a set of regular trucks, which are placed on a standard gage track leading out into the yards.

Painting Pennsylvania All-Steel Box Cars

The roof is next added. The last operation inside the shop is riveting on the side ladders and hand-holds and applying the hand-brake equipment. The car is pushed out into the yard, where it is cleaned with benzine to remove grease. It is then ready for painting.

A steel box car in the course of construction occupies eight positions on the erecting tracks and goes through twenty-seven classified operations, each of which, of course, embraces the doing of a multitude of things. The 5,100 rivets which are beaten into place with the pneumatic tools hold together 129 pressed steel parts in each car. The car, with its trucks and equipment complete, weighs 50,000 pounds, and has a carrying capacity of double that.

In building steel box cars this company is following its policy of making steel the standard form of construction for all its cars. The Pennsylvania Railroad was the first to adopt steel passenger cars, and now owns more than any other railroad in the world.

SERVICE OF NORFOLK & WESTERN 90-TON CARS

The Norfolk & Western has had in use for over two years 750 of the 90-ton capacity gondola cars which were described in the *American Engineer* for January, 1913, page 35, and 1,000 more are now on order. The accompanying table gives some interesting figures for these cars in comparison with 57½-ton cars also used on this road in coal service:

COMPARATIVE DATA ON NORFOLK & WESTERN COAL CARS

Car.	Light weight.	Pounds of coal in heaped car at 58.85 lb. per cu. ft.	Gross weight.	Volume in cu. ft. Level.	Volume in cu. ft. 30 deg. heap.	Volume in cu. ft. Total.	Pounds lt. wt. of car per cu. ft. of heaped capacity.	Ratio of revenue load to total load, based on heaped coal load at 58.85 lb. per cu. ft.	Number of cars in a 5,000-ton train, cabin car not included.	Tons of coal in a 5,000-ton train, cabin car not included.	Coupled length of car.	Length of a 5,000-ton train, cabin car not included.
57½-ton all steel hopper. Class HP. Two 4-wheel trucks.	42,000	125,400	167,400	1,807	327	2,134	19.7	75.0	59.7	3,743.19	33 ft. 5½ in.	2,000 ft.
57½-ton all steel gondola. Class GJ. Two 4-wheel trucks.	43,500	116,200	159,700	1,547	429	1,976	22	72.8	62.2	3,637.06	41 ft. 10¼ in.	2,620 ft.
90-ton all steel gondola. Class GKa. Two 6-wheel trucks.	59,300	198,900	258,200	2,829	551	3,380	17.5	76.9	38.7	3,850	48 ft. 9 in.	1,887 ft.

Underfeed Stokers and Combustion.—An underfeed stoker is able to smokelessly burn even high-volatile coals, because when the volatile is distilled, it must pass through the hottest part of the fuel bed before getting out into the furnace. Besides a sufficiently high temperature, the only other chief requirement for the proper burning of the volatile is time, just as it takes time for a cake of ice to melt at summer heat.—*Power.*

French Fuel Binder.—A fuel binder recently patented by a French maker, which is fusible to a vitreous mass at 200 deg. C., consists of 15 parts of glassmaker's sand, 18 parts of Portland cement, and 10 parts of carbonate of soda or other flux for silica, such as sea salt or sulphate of soda. Dry fuel dust, such as coal in grains up to 5 mm. in size, is mixed with from 4 to 6 per cent of the mixed binding ingredients, the product, with the addition of 8 per cent of water, being compounded in a mixer to which steam under 8 kilos. pressure, at 170 deg. C., is admitted, the mass subsequently being pressed into briquettes. Heat may be applied to the material issuing from the press to increase the cohesion.—*Engineer.*

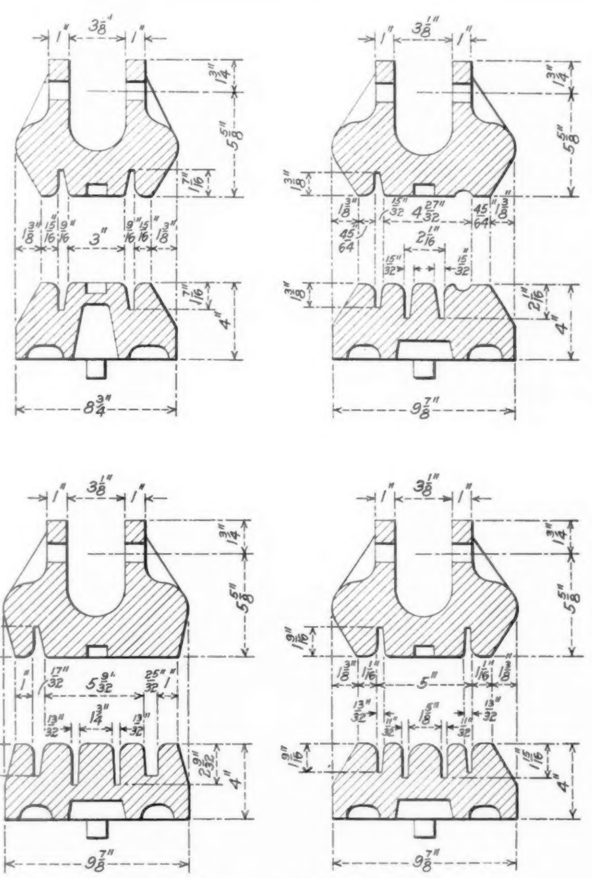
Shop Practice

BRAKE BEAM STRAIGHTENING PRESS

BY E. F. LICKEY

One of the difficult and laborious jobs in a car repair shop is the repairing of the various types of brake beams which come in for straightening and the renewal of parts. The most difficult tasks are the stripping of the beam, which is done largely by manual labor, and the straightening of the beam after being stripped. The beam is usually straightened on a face plate with a sledge hammer and flatter after it has been brought to a red heat in an oil furnace. This operation is made difficult by the thin flanges and webs of the various members and because of the variety of twists and kinks encountered.

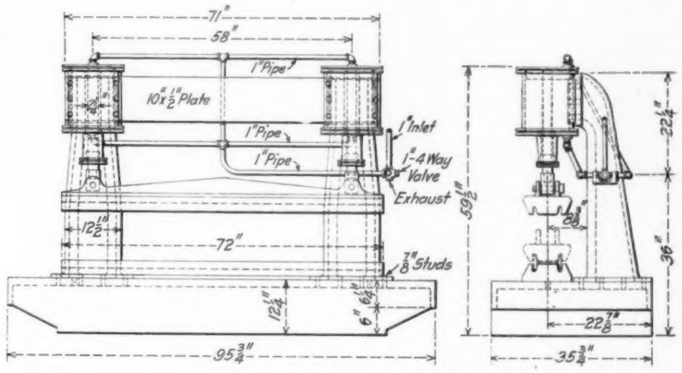
The best plan for performing this work is to concentrate



Sections of Some of the Dies Used

it for an entire road at one shop where tools and facilities can be maintained for doing the work to the best advantage. Brake beam work for the New York Central west of Buffalo is taken care of at the Air Line Junction car shops (Toledo, Ohio), the brake beams being shipped in to this point, repaired and returned to the other car repair points. In order to get away from the laborious hand method it was thought desirable to provide some kind of a press for straightening the beams, the development of which was assigned to the writer. The problem of designing a press which would do the work desired was rather difficult on account of the great variety of sections to be handled, but a pneumatic press having two cylinders mounted as shown in the drawing, was finally decided upon.

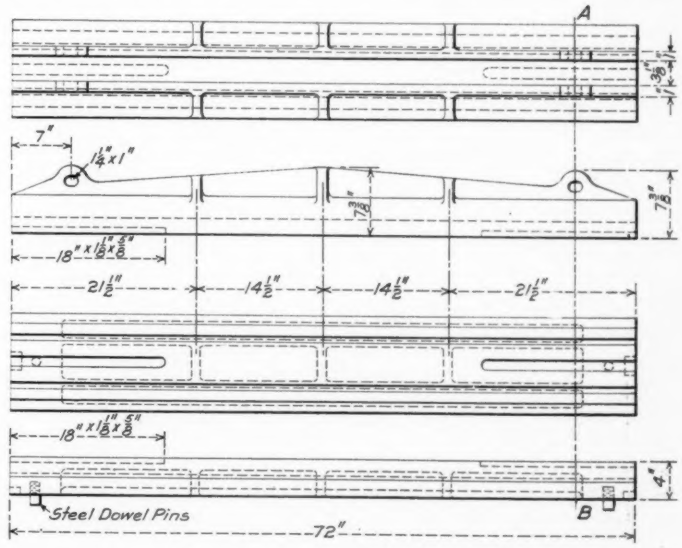
In order to keep the cost as low as possible the machine was made up mostly of material or patterns for parts already at hand. Patterns were already available for the large face plate forming the base and for the cylinders and cylinder heads so that the only ones which were required new were those for the dies and columns. The cylinders used were 10-in. waterscoop operating cylinders. The press was piped up as shown in order to get a uniform flow of air to the two



Press for Straightening Brake Beams

cylinders and to prevent as far as possible any binding due to one piston coming down ahead of the other.

In handling the beams it is usually customary to group the various types of beams together. They are then stripped and the dies for the particular kind to be handled applied to the straightening machine. The beams are heated in an oil furnace large enough to take the entire beam and when brought to a red heat they are withdrawn by suitable tongs or hooks and taken to the straightening press. Small kinks in the flanges of I-beams are first hammered out and the



Dies for Brake Beam Straightening Press

beam is then inserted in the dies. Sometimes more than one operation is necessary to straighten a badly twisted beam, but a much better job is done than with the old method of straightening with sledge and flatter. It is unnecessary to change dies for each type of beam as it is possible to use the I-beam dies for a number of bulb beams. This is an advantage as the dies are heavy and difficult to handle.

The use of a 12-in. or 14-in. cylinder in place of the

10-in. cylinder shown would probably be of considerable advantage. The additional pressure secured would be desirable when more than one operation is required as the beam often cools slightly between operations. The machine is operated on 80 lb. to 100 lb. air pressure.

Details of some of the dies which are being used are shown and it will be noted in some cases that they are made to take two different styles of beams, thus reducing the number of dies required. The press has been in operation for several months and has proved very satisfactory.

PATCHING BOILERS

Since the inauguration of the Federal boiler law, locomotive boilers are being patched, when this becomes necessary, in a variety of ways, some of which are good, while others reflect but little credit on those who do the work. One or two roads are carrying out this work entirely through the drawing office, a sketch being furnished the mechanical engineer by the shop officers. The drawing office then determines the best method of patching and

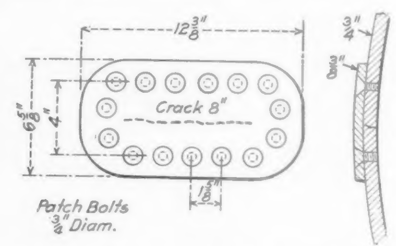


Fig. 1—A Bad Example of Boiler Patching

issues a blueprint. One large road in particular is having conspicuous success with this practice.

Returning to the discussion of patches in general, Fig. 1 represents a patch applied by shop forces without first receiving proper instructions from the drawing office. It will be noted that the patch is applied with patch bolts instead of rivets, and that the patch material is only 3/8 in. thick instead of the thickness of the shell sheet. The efficiency of the single riveted seam in this patch is very low

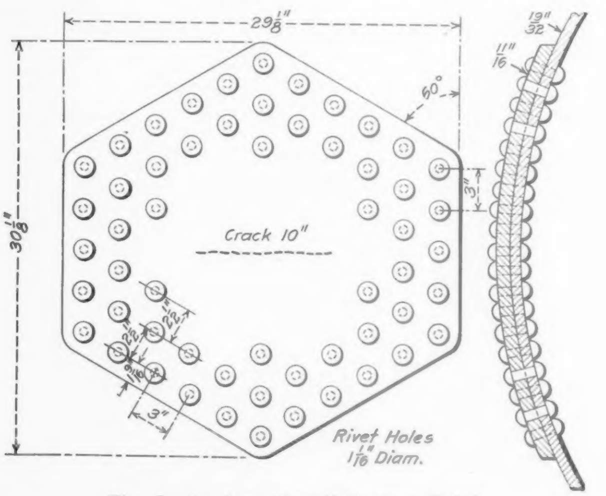


Fig. 2—Another Unsatisfactory Patch

and the factor of safety of the boiler has been materially reduced. The efficiency of the longitudinal seams in the shell of this boiler is 84 per cent. It is needless to say that such patches are very unsatisfactory.

Fig. 2 shows a patch applied in accordance with general instructions from the drawing office. These general instructions cover all patches and the patches are applied by the shop before the drawing office is advised of the defect. In this case it would appear that the drawing office did not calculate the efficiency of the patch before the general instructions were issued. This patch is unsatisfactory and it will be necessary that it be removed or the boiler pressure reduced. The efficiency along the outer row of rivets can be found by calculating the seam as a diagonal seam. Many railway men would probably criticize this patch because of its unusual size and the large number of rivets used. It is, of course, possible to apply a smaller patch with fewer rivets at less expense, which would be materially stronger.

Fig. 3 illustrates a patch which was applied after proper

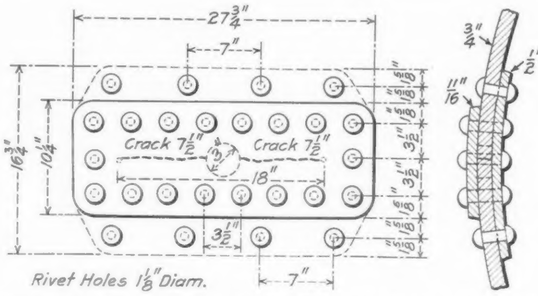


Fig. 3—A Patch Which Maintains the Factor of Safety

instructions were issued to the shop by the drawing office. In general these instructions are that in applying a patch the seam used should be as nearly as possible a duplicate of the longitudinal seam in the shell of the boiler. The pitch of rivets in the outer row of the seam is the same as the pitch of rivets in the outer row of the longitudinal seam. Comparing the patch shown in Fig. 3 with that in Fig. 2, it will be noted that it requires less material and fewer rivets and, of course, less time and money to apply the patch shown in Fig. 3. It will also be noted that although the patch in Fig. 3 is smaller than that in Fig. 2, the crack shown in Fig. 3 is nearly twice as long as the one shown

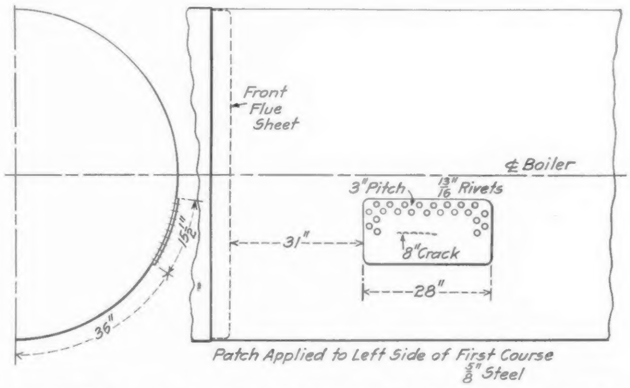


Fig. 4—This Patch Reduced the Factor of Safety to Less than Three

in Fig. 2. The factor of safety of the boiler was not reduced by applying the patch shown in Fig. 3.

The patch shown in Fig. 4 was applied to repair an 8 in. crack. It should be noted that a double-riveted lap joint is used for this patch, the efficiency of the seam being 70.8 per cent. The longitudinal seam on this course is a diamond seam with a calculated efficiency of about 96 per cent. The patch reduced the factor of safety of the boiler from over four to less than three.

PROTECTION OF BLOWOFF PIPES.—The blow off of a stationary boiler should be opened frequently enough to keep the pipe clear, and a bottom blowoff pipe that would be exposed to direct furnace heat should be protected by firebrick, a substantial cast-iron removable sleeve or a covering of non-conducting material.—*Power.*

The Voice of the Apprentice

Many railroads have made special efforts in recent years to attract young men to enter the shops and train them to become intelligent, efficient mechanics. What does the apprentice think of these methods and the treatment accorded him, and how in his opinion can they be improved with a view to securing better results? To obtain an expression from the apprentices a competition was announced in our issues of January and February.

As noted in the editorial columns, the first prize was awarded to J. C. Bowman, an apprentice at the Avis shops of the New York Central, and the second prize to E. C. Crawford, a machinist apprentice at the Drifton, Pa., shops of the Lehigh Valley Coal Company. Twenty-seven contributions were received from apprentices of the Lehigh Valley Coal Company and ten from apprentices on different railroads. The railroad contributors were M. R. Brockman, apprentice at the Spencer (N. C.) shops of the Southern Railway; William Heise, third year machinist apprentice, Erie Railroad, Jersey City, N. J.; William Johnston, fifth year locomotive apprentice, Canadian Pacific, Montreal, Que.; A. T. Kuehner, assistant road foreman of engines, Baltimore & Ohio, Newark, Ohio (apprenticeship completed February 15, 1915); William L. Lentz, machinist apprentice, New York Central, Avis, Pa.; Arthur J. Merriman, boilermaker apprentice, Atchison, Topeka & Santa Fe, Richmond, Cal.; Nielsen Pollard, fourth year apprentice, Atchison, Topeka & Santa Fe, Albuquerque, N. Mex.; Carl J. Pryor, fourth year apprentice, Atchison, Topeka & Santa Fe, Clovis, N. Mex.; T. S. Tulien, special apprentice, Atchison, Topeka & Santa Fe, Topeka, Kan.

The Lehigh Valley Coal Company apprentices at Drifton, Pa., who participated were James Bowen, Howard F. Brauch, Victor E. Brauch, Albert W. Breyfogel, Thomas D. Brobst, Frank Chicalace, Charles M. Crawford, Harry E. Davis, Tony De Grosse, Charles A. Giula, Stanley Hontz, Frank M. Jenkins, James Kennedy, Elmer Klein, Emanuel Korn, Clayton Kresge, Harrie E. McClellan, Bernard Murrin, Louis J. Polanerzky, Clifford L. Sachs, Emery Shanno, Charles Sweeney, Jr., Henry Thomas, Paul Tucker, Percy Turnback and Wilbert P. Wehner.

The two prize articles, with others, appear in this issue. A large number of the other contributions are well worth publishing, either in whole or in part, and will appear in future issues.

FIRST PRIZE ARTICLE

BY J. C. BOWMAN

Apprentice, New York Central, Avis Shops, Jersey Shore, Pa.

The larger railroads have organized apprentice systems and have provided class-rooms, in which the apprentice is obliged to spend a certain number of hours each week. Here he is instructed in mechanical drawing, sketching, blue-print reading, the common school studies, and the theory of his trade. This program, in conjunction with his practical experience in the shop, should make of him, at the end of his apprenticeship, a highly efficient mechanic.

These railroads are offering to the young man who wishes a technical education, and who cannot afford to get it at some college, an opportunity to realize his ambition.

Concentrating his mind exclusively on his work, both in the class-room and in the shop, helps the apprentice more than anything that can be done for him by his class instructor or by his shop foreman. To inspire him to thus concentrate his mind and to work to the limit of his ability, he has the knowledge that when he finishes his apprentice period, or as soon afterwards as an opportunity occurs, he will be promoted to a position of trust.

The practice of placing the apprentices on their own responsibility seems to make the greatest appeal to the bulk of the apprentices in their course of training. This is done by giving an apprentice charge of a job, with an assistant. It shows that some trust is placed in him and influences him to work harder to be worthy of this trust. This method also teaches him to think for himself.

So, all in all, the apprentice of today is pretty well provided for, both during his apprenticeship and afterwards. However, there are improvements that could be made in the apprentice systems that would make them of more practical value to the apprentices. Enough school work is not required of the apprentices outside of school hours. If a young man wishes to learn he should be willing to do anything required of him by those who make it possible for him to realize his ambition. Then again it might be an incentive to closer application to work if the diploma, which the industrious apprentice receives, showed him to be a man of higher standing than the one received by the apprentice who merely drifted through his apprentice period.

SECOND PRIZE ARTICLE

BY E. C. CRAWFORD

Machinist Apprentice, Lehigh Valley Coal Company, Drifton, Pa.

Although an apprentice of only a few months' experience in the machine department of the Drifton shops, I have had evidence of the interest and co-operation which the management shows in its dealings with its employees. Its effort to keep working conditions the best possible, maintaining sanitary shops—clean, well-lighted, and ventilated—serves as an inducement for workers to try more conscientiously to serve their employers.

The endeavor to prove to us that they consider us more than mere cogs to grind out dollars for their industrial machine is doubly inspiring, as it shows they wish us to live, not merely exist.

From the apprentice's viewpoint, I firmly believe the following slight changes in attitude and management would prove beneficial to us:

(1) A little more leniency in punishment for shortcomings.

(2) Recommendations upon our entering a department,

as to the tools which shall be required, where to acquire them and what make has met with the management's approval and is the uniform standard for its master artisans.

(3) Monthly lectures by the heads of the various departments dealing exclusively with the work of their distinct division, for which lecture the student apprentice should receive some preliminary coaching as to the proper method of jotting down notes, so that he may note the vital points the foreman intended to convey.

(4) Establishment of a small circulating library dealing exclusively with systematic methods of production and technical work.

(5) A method of systematic, rather than periodic advancement as the apprentice familiarizes himself with the work of a distinct department.

(6) Establishment of a system of awarding slight bonuses to those artisans excelling in rapidity of production, thus causing the awakening of a keen sense of rivalry (altogether friendly, however), thereby causing an efficiency as regards production, amounting to practically 100 per cent.

(7) A recommendation that all apprentices attend some local night school, not making it compulsory, but presenting such inducements to those who do attend that those negligent in such matters will see that it is to their interests to do so.

SOME PRACTICAL SUGGESTIONS

BY M. R. BROCKMAN
Machinist Apprentice, Southern Railway, Spencer, N. C.

Two incidents that encouraged me very much were (1) the superintendent of motive power inquiring if I were making good and offering any advice that I might desire; (2) the master mechanic gave me leave of absence with transportation, so that I could attend a special short course at school, saying that my apprenticeship would not be lengthened to make up for my absence, because I tried to do my best.

These incidents showed that the officers were interested in my progress, so I worked harder that they would continue to be interested and willing to help me.

Several days ago I asked the shop superintendent if he would kindly hold open one of the machinist vacancies until my apprenticeship expired, in about two months. He said: "I will gladly do this, young man; I wish that your time was out now, so that I could put you at the regular machinist's work." This incident showed that my efforts were not in vain, so I set out to make the last two months of my apprenticeship the most successful of all.

The present apprentice courses with the shop drawing school are efficient, but I think can be improved. The apprentice school can be improved by having a practical man that will teach more about shop kinks than drafting. The ordinary machinist's pay is nearly twice that of a fairly competent draftsman. Why not teach the apprentice about the locomotive which he will have to work upon, instead of drafting, which is another trade.

Reading drawings is the chief benefit derived from the study of drafting by the apprentice. This serves its purpose, but is a slow method. Why not teach the reading of drawings more efficiently and use the hours formerly spent in practising lettering and crosshatching, etc., for instruction in the advantages of different types of valves and valve gears, angularity of main rods, equalization of springs, the theory of air brakes, safety appliances, etc.

Instruction such as the above would certainly interest the average young man, and at the completion of his apprenticeship he would be a capable railroad machinist. Knowledge of the theory of machinery frequently prevents bad judgment when repairs are to be made.

I find that the work is much more interesting and that I learn a great deal more when working with some expert mechanic than with a group of apprentices under one foreman. Each mechanic has different labor and time-saving methods which would not die when they do, if the apprentice were given an opportunity to learn them; and the apprentice would be better informed if this practice were more commonly followed.

A SUGGESTION TO OFFICERS

BY A. T. KUEHNER
Assistant to Road Foreman of Engines, Baltimore & Ohio, Newark, Ohio

(*Apprenticeship completed February* 15, 1915)

My career as an apprentice with the Baltimore & Ohio was exceptionally interesting. I began in the erecting shop, spent a few months each in the machine shop, air brake department, car shops, roundhouse, and the last six months with the road foreman of engines, this covering a period of three years.

The methods employed by our road in handling apprentices, both in personal treatment and mechanical teaching, can, I dare say, hardly be improved upon. Each apprentice enters under a certain class, according to his schooling, and is scheduled to follow out special instructions covering that class. Our mechanical instructor, a thorough, practical man, fair and square to all, has charge of the apprentices and sees to it that all boys receive proper instructions, fair treatment and are made to follow out the schedule. Then we also have an apprentice school, where we are taught the rudiments of mechanical drawing. Each apprentice attends school twice a week, from seven to nine in the morning; to make this work more interesting the company at the end of the term gives the three best and most energetic workers prizes that are well worth striving for.

At the close of the apprentice school the boys usually give a banquet and invite the higher officers, and the invitations are always gladly accepted. At one of these banquets I received my greatest inspiration, sitting among these great men, and hearing their early and wonderful careers and how they advanced step by step—really the finest kind of advice and encouragement. One statement in particular, made by one of our mechanical officers, stating that he felt the apprentices of today were not qualifying themselves for official positions as they should, being proved by the fact that there were more positions open in the supervising capacity than there were in the journeyman class, but no material available to fill them with, appealed to me strongly.

Boys, right here was where I stopped thinking of the impossible, and the thought of just finishing out the day. Instead I worked with renewed energy, and not very long afterward saw results forthcoming. And today I am more proud than ever of having heard this statement and the effect it had upon me, as it has led me to a position where the greatest future can be obtained. Can't more meetings of such a kind be arranged for, where the apprentices may meet the higher officers, to let the apprentice know he is being thought of and to hear the words that were so inspiring to me?

THE SANTA FE METHOD

BY T. S. TULIEN
Special Apprentice, Atchison, Topeka & Santa Fe, Topeka, Kan.

One of the great questions with which the present-day manufacturers have had to deal is that of obtaining workmen, not only skilled and efficient but familiar with their peculiar requirements and from whom they can develop and choose men for executive positions. This has been solved to a great extent by the apprenticeship system. It not only gives to the company good workmen but offers the opportunity to observe which men are fitted to serve as foremen, or in higher official capacities.

The benefits are not restricted, however, to the manufacturer alone, but offer advantages to the apprentice himself which could be derived in no other way. There are a great many young men who are capable of holding good positions.

but are held back by their own timidity. If these same young men were to learn a trade under the old apprenticeship system, they would have nothing more than just the bare machanical practice at the end of their courses. If they were observed at all it was only with reference to the kind of work they were turning out. Under the present system these young men come into direct contact with men who realize their ability and with a little help on their part are able to push ahead. By this means the young man is given not only the chance of earning a good livelihood, but a good substantial foundation for building his career.

The Santa Fe, under the supervision of F. W. Thomas, has an especially good system. This course covers a period of four years, during which time the apprentice is put through the various operations comprising his trade. The apprentices are divided into groups, and each group is put under the supervision of an instructor. These groups are small enough to allow the instructor to give a great deal of personal attention to each boy.

Before entering the course the applicant is required to pass a mental as well as physical examination. Although the examination is simple it is of such a nature as to show clearly the boy's ability to advance. The applicant must be between the ages of 16 and 21.

Upon entering the shop the apprentice is given the more simple operations and is advanced step by step, the period of time for each depending on the nature of the work, until, at the end of 12,000 hours, he has passed through all the typical operations. Apprentices of 21 years or over are required to fire locomotives on trial trips. This gives them the opportunity of observing the methods of handling and firing locomotives and also of locating defective work.

Besides the work in the shop the apprentice receives four hours of schooling each week. In the schoolroom he is taught mathematics, drawing, writing, and things pertaining to the department in which he is working.

Apprentices in the fourth year are required to attend night school one evening each week for a number of the winter months. These night schools cover various phases of the work in which he is interested. A competent instructor is placed in charge of each class. At different periods during the course men well versed on the subject are invited to address the respective classes.

Another feature which is proving very satisfactory was added about a year ago. This is a special course open to special apprentices in their third year, or journeymen apprentices in their fourth year. Apprentices for this course are selected by the local mechanical department, upon approval of the mechanical or shop superintendent and supervisor of apprentices. This course gives the young man an opportunity of preparing himself for general railroad work. It consists of two months in the boiler shop, two months in the car shops, four in the roundhouse, two with the road foreman and two months inspecting locomotives. Besides this work a course of reading, prescribed by the supervisor of apprentices, must be pursued by the apprentice. At the end of each month he is required to write a letter to the master mechanic telling of the work in which he has been engaged and offering criticism and suggestions. Also, at the end of each division of the course, he must be able to answer a set of questions covering that work. This last feature is especially good, for it gives the apprentice a knowledge of the things upon which to lay most stress.

As a conclusion it might be said that the advantages to be gained by the apprentice cannot be estimated, for they depend to a great extent on the apprentice himself. He must be willing to take an interest in his work, work hard and study. For my part, I am just beginning to realize all the advantages that I have gained. Perhaps one of the greatest was the opportunity I had of obtaining the Ryerson Scholarship, enabling me to take a four-year course at Purdue University.

A RECORD CYLINDER WELD

Ever since the oxy-acetylene welding process has been in general use in locomotive shops instances have been mentioned of the success with which locomotive cylinders have been welded by this process. To those who have had but little experience in this connection, a certain job done at the Kansas City shops of the St. Louis & San Francisco will appear remarkable.

From Fig. 1 it will be seen that the cylinder casting was

Fig. 1—Broken Locomotive Cylinder That Was Repaired by the Oxyweld Process

broken in two pieces. Fig. 2 shows these two pieces welded in place. The cylinder was placed in service without being bushed and with no reinforcement except for the ring on the end of the cylinder, which is now believed to have been unnecessary, and has been running for some time successfully. John Foster, master mechanic in charge of the shops at which this work was done, describes the work as follows:

"The two broken parts were V'd out and clamped together in a true circle and placed on a blacksmith's fire,

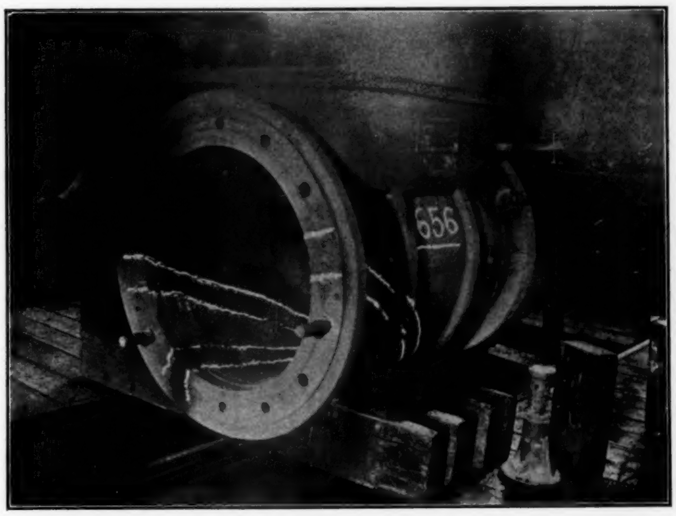


Fig. 2—The Welded Locomotive Cylinder

preheated and then welded together on the fire. This left one piece instead of two. This piece was then put up in the cylinder with what would be termed an arch clamp. This clamp was bent up in the shape of a U flattened out at each end and attached to the two studs in the cylinder next to the broken part, the idea being to give the operator

an opportunity to do the work without any of the surface of the clamp interfering. The cylinder was preheated to a good cherry red by a wood and charcoal fire and kept at an even temperature during the entire process of welding. Two operators were used, one from each end of the cylinder. The torches were extended, making them much longer in order to keep the operators as far away as possible from the intense heat. After the welding was completed the cylinder was thoroughly heated again by building a good charcoal fire inside and out, the fire being maintained until the entire work was uniformly heated. It took nearly 24 hours to bake the cylinder and allow it to cool off gradually. Below is an itemized statement of the cost of renewing the cylinder under the old method and the cost of welding by the Oxweld method:

OLD METHOD

Cost of cylinder finished	$230.00	
Other material	19.28	
Labor removing old and applying new cylinder	55.65	
	$304.93	
Less value of scrap cylinder	31.70	
		$273.23

OXY-ACETYLENE METHOD

Labor preparing	$4.50	
Wages of burner operators	7.20	
Cost of Oxweld material	26.36	
Labor finishing	19.00	
		57.06
Total saving		$216.17

The time required to do this job was as follows:

Preparing	1 day	Grinding in the head	1 day
Welding	1 day	Finishing	1 day
Annealing	1 day		
Boring and finishing cylinder	2 days	Total	7 days

"The credit for this work is due C. R. Kew, general foreman, and Martin Whalen, foreman blacksmith, at these shops."

HIGH SPEED STEEL TIPPED LATHE TOOLS

BY E. J. McKERNAN
Supervisor of Tools, Atchison, Topeka & Santa Fe

In order to derive the greatest use from our available high speed steel we have tried in many ways to weld high speed steel tips on tire or carbon steel shanks, and have now accomplished results that are entirely satisfactory. We find that the oxy-acetylene process is best for doing this work. The method followed in making the weld is shown plainly in Fig. 2. The carbon steel holders must be forged as indicated in order to get the best results; also, it is necessary to forge the high speed steel tips to as nearly the proper dimensions as possible before the weld is made. When welding the tips should be heated to about 2,200 deg. F. and the side that is welded to the carbon steel shank should be faced with Norway iron. In making the weld a good grade of special rolled steel must be used, the tip being welded to the shank by the oxy-acetylene process at the points indicated in the drawing. A large number of the carbon steel shanks and the high speed steel tips should be made up so that the work can be done quickly. This work is done in the blacksmith shop, but the welding is done by an expert gas welder. After the welding has been completed it is necessary for the tool grinder to grind the tools to the proper shapes.

On our wheel lathes we have been able to turn out 250 pairs of coach wheels with a pair of tools which were 2 in. by 3 in. by 20 in. These tools have given excellent service and we are able to keep up the same speed as when we used the solid high speed steel tools. Furthermore, we have had the tips "break down" on one of the welded tools, and have redressed them practically in the same manner as the solid high speed steel tools are redressed. This was done successfully without the high speed steel tip becoming loose

Size	C	D	E	F	G	H
$\frac{1}{2}$" x 1" x 8"	$\frac{3}{8}$"	$1\frac{1}{2}$"	$\frac{1}{2}$"	$\frac{3}{8}$"	$\frac{5}{8}$"	$1\frac{1}{8}$"
$\frac{5}{8}$ x $1\frac{1}{4}$ x $8\frac{1}{2}$	$\frac{3}{8}$	$1\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{8}$	$\frac{7}{8}$	$1\frac{1}{2}$
$\frac{5}{8}$ x $1\frac{1}{2}$ x $8\frac{1}{2}$	$\frac{3}{8}$	$1\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{8}$	$1\frac{1}{8}$	$1\frac{3}{4}$
$\frac{3}{4}$ x $1\frac{1}{2}$ x 9	$\frac{3}{8}$	$1\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{8}$	$1\frac{1}{8}$	$1\frac{7}{8}$
$\frac{3}{4}$ x $1\frac{3}{4}$ x $9\frac{1}{2}$	$\frac{3}{8}$	$1\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{8}$	$1\frac{3}{8}$	$1\frac{5}{8}$
$\frac{7}{8}$ x $1\frac{1}{2}$ x 10	$\frac{3}{8}$	$1\frac{3}{4}$	$\frac{7}{8}$	$\frac{3}{8}$	$1\frac{1}{8}$	2
1 x 2 x 12	$\frac{9}{16}$	2	$\frac{7}{8}$	$\frac{9}{16}$	$1\frac{7}{16}$	$2\frac{5}{16}$
$1\frac{1}{4}$ x 2 x 14	$\frac{9}{16}$	2	$\frac{7}{8}$	$\frac{9}{16}$	$1\frac{7}{16}$	$2\frac{5}{16}$
$1\frac{1}{2}$ x $2\frac{1}{4}$ x 18	$\frac{9}{16}$	$2\frac{1}{2}$	$1\frac{1}{4}$	$\frac{9}{16}$	$1\frac{11}{16}$	$2\frac{15}{16}$
2 x 3 x 20	$\frac{5}{8}$	3	$1\frac{1}{2}$	$\frac{5}{8}$	$2\frac{3}{8}$	$3\frac{7}{8}$

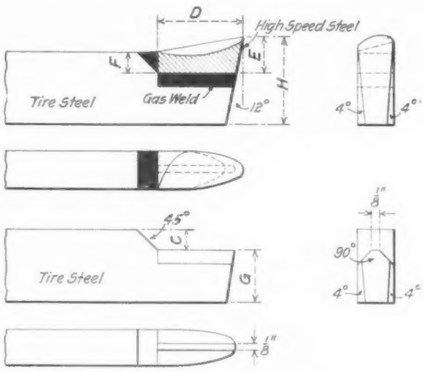


Fig. 2—Method of Welding High Speed Steel Tips to Carbon Steel Tool Shanks

on the carbon steel shank. To redress these tools successfully it has been found advantageous to draw the part of the tool underneath the tip down to about $\frac{1}{4}$ in. below the bottom surface of the tool. It is then placed under a steam hammer and a blow is struck on the top surface directly back of the welded tip. This will return the point of the tool to the proper place, giving it the proper shape, etc. We have adopted this plan over the entire system and it is giving complete satisfaction so far. The work is so well done that it is practically impossible to tell where the tool is welded and the performance of these tools is equally as good as that of the solid high speed steel tools. Fig. 1 shows a group of tools welded by the method described.

FRICTION.—Friction of lubricated surfaces is determined by the nature of the lubricant rather than by that of the solids or bearing metals themselves.—*Power.*

RUNNING AN ENGINE OVER.—The advantage of this is that the pressure of the crosshead is always downward upon the guide. If the engine is run under, the thrust of the crosshead will be upon the top guide on both the outward and inward strokes, and unless the crosshead is properly adjusted, it will lift when subjected to thrust and fall by its own weight on the center, making the engine pound.—*Power.*

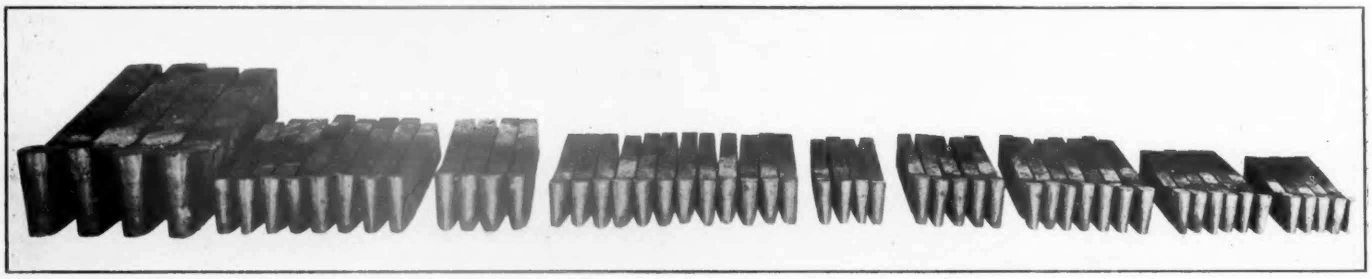


Fig. 1—Group of Lathe Tools with High Speed Steel Welded Tips

ESSENTIALS OF SHOP EFFICIENCY

Discussion of the Features of Scientific Management Which Are Applicable to Railroad Shops

BY G. W. ARMSTRONG

Scientific management is by no means inapplicable to railroad work. A common mistake, however, is to disregard the fundamental fact that a railroad shop is not and cannot be handled as a manufacturing shop in the strict sense of the word. Its organization on the scientific basis of the best productive efficiency is impossible. Shop systems must be subordinate to the keeping of locomotives in service by reducing the time they are in the shop. With this essential for guidance, the principles underlying scientific management can be applied. Line and staff, standards, the time study and scheduling and routing all have possibilities in their application to railroad shops.

The size of the staff organization required is dictated wholly by the extent of the system to be covered. The duties of the various staff officers are the same for any size road although where the expense is unwarranted the functions of more than one may be vested in one person. Much of the success or failure of such an organization depends upon the man selected as its head, the efficiency engineer, shop specialist or whatever title he is given. He should be vested with sufficient authority to create respect for his orders and suggestions and yet in no way connected with the actual shop management, but reporting to the chief mechanical officer. The assistant engineer, or machine tool specialist, should be equally as capable as the shop specialist, but, primarily, he should have an intimate and thorough knowledge of machine tools. All matters relating to their maintenance and operation should be supervised by him and his opinion should have considerable weight in the selection of new equipment. Upon the shop demonstrators devolves the detailed work of the organization. From time studies made by them at the various shops are worked out the instruction cards, referred to later. Owing to the tendency to use them for other duties, these men should be under the jurisdiction of the shop specialist and should also be transferred from shop to shop at intervals in order that they may thoroughly acquaint themselves with the varying conditions at different points on the system. Should the establishment of a manufacturing department be considered advisable, the shop superintendent of such a plant should report to the shop specialist rather than to any local officer.

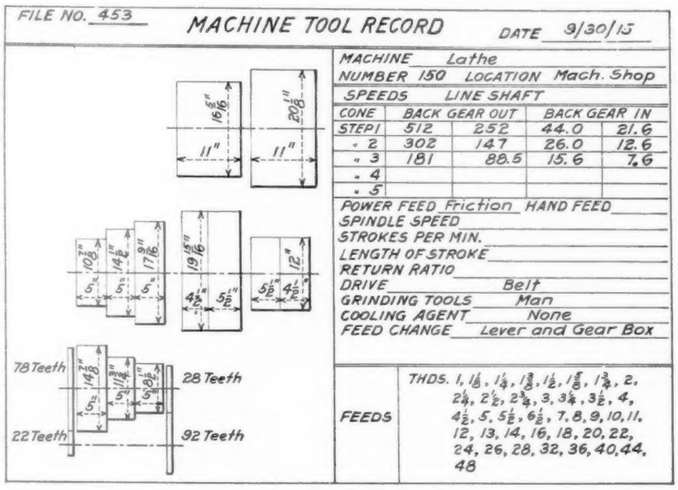


Fig. 1—Machine Tool Record Card

Having effected an organization, the first step must be a study of conditions with a view to improvement and standardization. This will require considerable detail, consume much time and owing to the absence of immediate tangible results will tend to a distrust of the value of the plan unless the full co-operation of the management has been secured. Plans should be worked up showing the various tool layouts and a thorough study made of the location of each tool with respect to its source of raw material and the destination of finished product. This study will undoubtedly indicate the advisability of relocating certain machines to promote greater efficiency.*

Related to the determination of proper machine tool location is the preparation of the machine tool record cards shown in Figs. 1 and 2. The data on these cards enables a comparison of the productive efficiency of machines in the various shops to be made and serves a useful purpose in judging the possibilities for standardization of machine tool operations in the various shops. The preparation of these record cards will often reveal wide discrepancies in the speeds and speed changes of similar machine tools from different manufacturers and in the installation of the same machine tools at different shops. As a preliminary to the preparation of standardized conditions, it is essential that these variations be corrected as much as consistent with the work performed. This alone in many cases will effect notable increases in efficiency, as many tools are not speeded to give the best results.

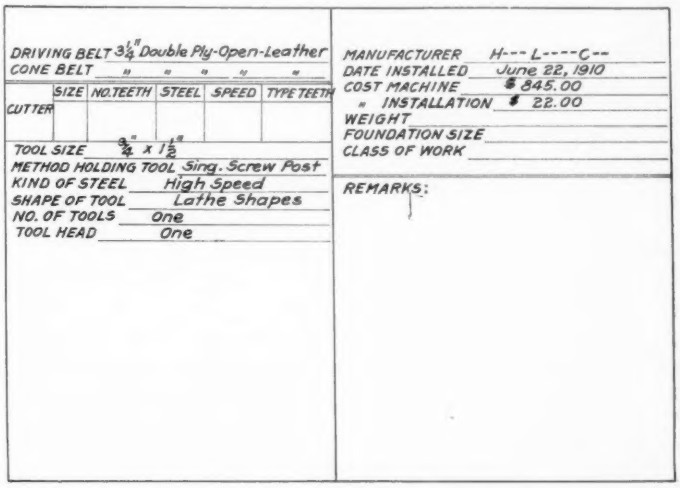


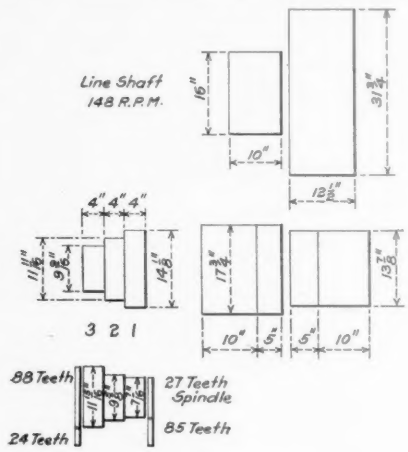
Fig. 2—Back Side of Machine Tool Record Card

As an illustration of conditions of this kind actually encountered the diagrams in Figs. 3 and 4 are shown. These are for two 20-in. engine lathes purchased from the same manufacturer and installed at the same time. The lathe, the record for which is shown in Fig. 1, is another machine of the same type and from the same manufacturer. The three diagrams and accompanying data plainly illustrate the wide variations in speed changes which may exist between similar machines and show the necessity of standardizing conditions before attempting to realize any degree of standardization of methods.

Suppose a 12-in. valve chamber bushing is to be turned for

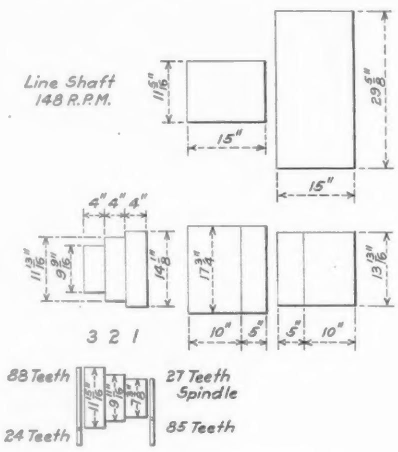
*For a discussion of the location of machines see an article by the same author on "General Machine Tool Efficiency," on page 255 of the May, 1914, issue of the *Railway Age Gazette, Mechanical Edition.*

chamber fit, the material being a good grade of gun iron and the best speed for the feed and depth of cut being 35 ft. per min. If the work is performed on the machine shown in Fig. 1 the machine must be run on cone 3 with the back gears, at 7.6 r.p.m. or a cutting speed of 24 ft. per min. The next available speed, 12.6 r.p.m., gives 40 ft. per min., or a speed which would probably prove too high for economical working. Thus we encounter a loss of about 33 per cent from the most economical cutting speed. Trying the machine shown in Fig. 3, we find that by using cone 3 with the back gears a surface speed of 29.8 ft. per min. is obtained, while the next step gives 45 ft. Thus again a loss of efficiency is unavoidable. With the machine shown in Fig. 4 the best conditions are found as by using cone 2 with the back gears, a speed of 32 ft. per min., with less than 10 per cent loss in efficiency, is obtained.



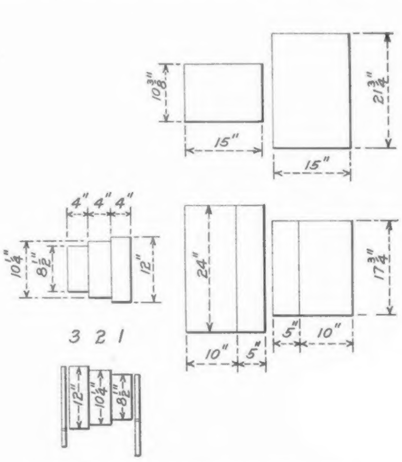
Cone	Open Belt		Back Gear In	
	Fast	Slow	Fast	Slow
Step 1	645.	254.	56.0	22.0
Step 2	411.	162.	35.6	14.0
Step 3	272.	107.	23.6	9.3

Fig. 3



Cone	Open Belt		Back Gear In	
	Fast	Slow	Fast	Slow
Step 1	608.	181.	52.8	15.7
Step 2	388.	115.	33.6	10.0
Step 3	254.	76.	22.0	6.5

Fig. 4



Cone	Open Belt		Back Gear In	
	Fast	Slow	Fast	Slow
Step 1	256.	90.5	32.0	11.3
Step 2	181.	64.0	22.6	8.0
Step 3	128.	45.2	16.0	5.66

Fig. 5

It will be observed that the interval between the speeds is very irregular. While the machines have twelve speeds, some of these are so high as to be of little or no use and others are so close together that they almost coincide, thereby in reality restricting the number of speed changes available. These conditions are indicated by the logarithmic chart in Fig. 6. This gives the cutting speeds for various diameters of work with the available spindle speeds, for the lathe referred to in Fig. 1. At the top, on a scale of spindle speeds, are shown the intervals between the various speed changes, the irregularity between the steps being clearly brought out.

In order to overcome these disadvantages, Carl G. Barth has suggested the use of the geometric progression for machine tool spindle speeds. The speed change conditions of a machine so designed are shown in Figs. 5 and 7, a geometric progression with a ratio of $\sqrt[4]{2}$ having been used. This gives speeds of 40 ft. per min. and 65 ft. per min. for the diameters ranging from 1 in. to 20 in., which are the most commonly used within the range of the machine. It will readily be seen from a comparison of the speeds available and the variations in these speeds that a lathe constructed similar to that in Figs. 5 and 7 possesses marked advantages for general work over the other machines.

The use of the time study is essential in the standardizing of methods. Upon the diligence and accuracy with which these studies are made rests much of the success of the efforts to increase efficiency. The operations should be thoroughly timed at the various points under differing conditions and with different operators, particular attention being given to feeds, speeds, cuts, special appliances used, methods of setting and notes as to inefficiencies with reasons and recommendations for their correction. Too much care and caution cannot be exercised in the setting of time limits, nor in recording the conditions under which and for whch each limit is set and the actual work and the degree of finish covered by each limit. A careful study should be made of these time studies and where feasible the best practice or a suitable combination should be drafted up in the form of an instruction card. The degree of refinement employed in making the time study and preparing the instruction card depends primarily upon the frequency with which the operation is repeated. Where possible one instruction card should be prepared for

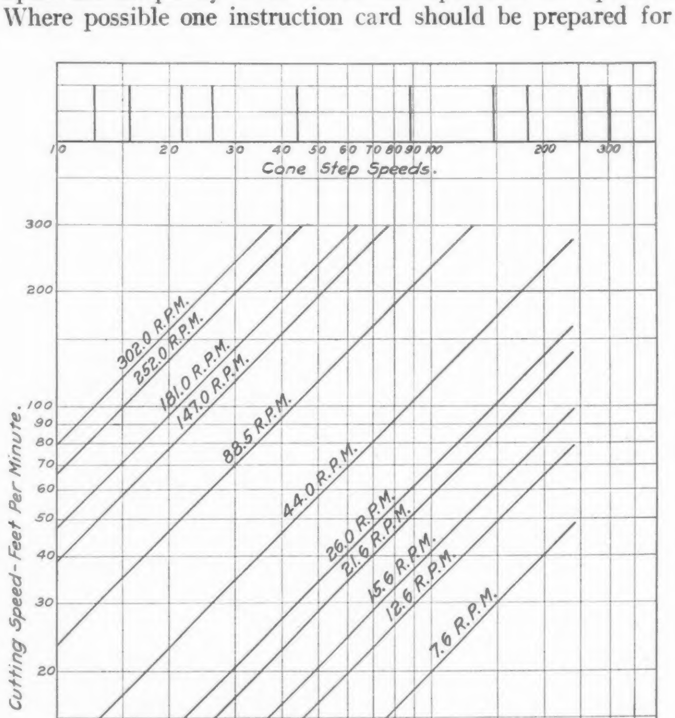


Fig. 6—Logarithmic Chart of Cutting Speeds of Lathe Referred to in Fig. 1

system use but often, owing to variations in the facilities at the various points, this is not feasible; in this case the minimum number possible should be used. Where operations, such as hydraulic press work, are performed at but one point,

time studies should be made independently by two or more shop demonstrators.

The instruction card gives the time allowance in detail with all necessary directions regarding special tools, appliances, method of setting, speeds, feeds, cuts, etc., and relieves both the workman and the foreman from the necessity of remembering any of the conditions. It becomes in reality a permanent record of the best practice for each operation.

Where instruction cards are completely and carefully prepared they may often serve to prevent drifting away from good, economical standards, through the loss of facilities. The possibility of this use of the cards is brought out by the following case, in which a special angle plate was constructed to hold eccentric halves, matching with a tongue and groove, for planing. As this ordinarily would necessitate an expensive set up, a large saving was effected and a reasonably small piece work price established by the use of the special fixture. In time, different workmen performed this operation and through lack of proper instruction, the jig was mislaid, the work being done without it. Soon the inevitable result followed; a complaint was made that the price was too low. In the investigation some one was found who remembered the old jig, and when it was discovered and again placed in service no further complaint was received. Had an instruction card been used, the jig would never have been lost.

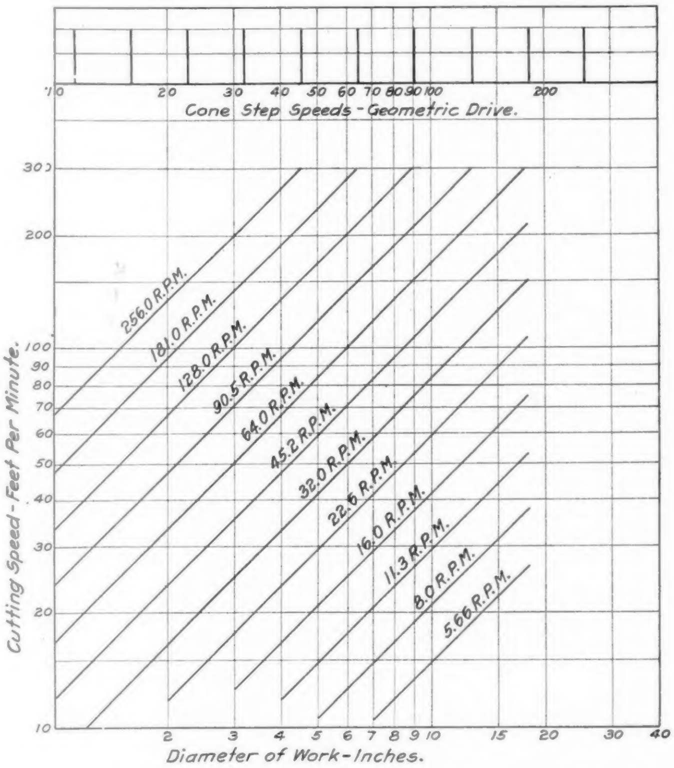


Fig. 7—Logarithmic Chart of Cutting Speeds of Lathe Referred to in Fig. 5

In the event of changing conditions as to material, size, machine tools and methods used, etc., the time studies and instruction card on file in the central office will serve as a means for quickly and thoroughly determining what effect these changes will produce and modified instruction cards can be issued.

The task of thus perfecting the method of performing each one of the innumerable operations occuring in a railroad shop would be one of inconceivable magnitude were it not for the great similarity of many operations and the possibility of developing new standards from the records of past performances combined with experience in their application.

While the foregoing has referred mainly to machine tool operations, the same methods are applicable and should be utilized for all operations, including those performed in the erecting shop.

In addition to the record previously mentioned a card record should be maintained at the central office for each individual machine tool, giving a record of all breakages, defects and repairs. Data for this record should be forwarded monthly from the shops. The same index number should be assigned to this card as is assigned to the machine-tool record card. Such a record as that described will prove of inestimable value in comparing the service of various makes of machines, in locating weaknesses and giving opportunity to strengthen them and also in indicating whether the cost of maintenance is becoming prohibitive. Aside from these advantages it is useful as an aid to the proper selection of new equipment.

Closely allied with machine tool efficiency is belt efficiency. This is an item commonly given little attention in the average shop. To realize the maximum of belt efficiency at a minimum cost the selection of the right type of belt for the conditions encountered, must be made at the outset. The application and maintenance should then follow a definite standard practice. The methods to be standardized may briefly be stated as follows:

Method of lacing.
Tension to be maintained and means provided for securing it.
Keeping belts clean.
Insure that belts do not wear against guards, shifters, or flanges of cone steps.
The use of a good belt dressing to keep belts pliable.
The placing of belts on pulleys so the hair side is next to the pulley, and the outside lap trailing when running ahead.

A belt record should be maintained and periodical inspections made, in order to anticipate breakdowns. Repairs should always be made outside of working hours.

A careful study should also be made to establish a line of standard tools. When warranted by the extent of the system a specialist should be placed in charge of this branch, his duties including the study of the heating, forging, tempering and grinding of tools, as well as their shapes and sizes. To insure correct maintenance, the tools should, as far as possible, be supplied from a central point and repairs carefully checked to insure that standards established are maintained.

Opinions vary as to the details to be employed in scheduling and routing locomotive repairs, but to secure the best results, it is necessary to so schedule each important division of the work that nothing is left to chance. A careful working out of such a system will assist materially in a well-balanced distribution of the working force, enabling all departments to work effectively, eliminating petty complaints, delays and misunderstandings and tendency to an improved shop output.

Where the system is of any size a manufacturing department is a very useful adjunct in securing decreased cost of maintenance. Such a department should be entirely divorced from the repair shop organization and operated as an outside concern. The repairs on structures and machinery, depreciation, interest on investment, power, oil, waste, defective material, etc., should be accurately accounted for and the output charged to the various shops at a price sufficient to provide for all these indirect charges as well as the labor, material and supervision.

VALUE OF EXHAUST STEAM FOR HEATING.—Under average conditions the steam discharged as exhaust from a stationary engine can be made to accomplish about 90 per cent as much heating as when in the form of live steam discharged direct from the boiler. But from the waste incurred by drips and leakage of back-pressure relief valves, the heat that can be realized in average plants where exhaust is used for heating is probably not more than 80 per cent of that contained in the steam supplied to the engine.—*Power.*

PROGRESS IN ELECTRIC ARC WELDING*

Practically every large railroad shop in this country is using the electric arc process with metal electrodes for flue welding. Welded tubes are practically permanent since the tube and the sheet are bonded together without a joint, leaving virtually no chance for leaks to develop. It has been found that the tube sheet, after the tubes have been removed, is in better condition than where the tubes have not been welded in. The welding builds up the sheet around the holes almost to the original thickness. It is essential that only a first-class operator be allowed to do work on the repair of boilers, because of the dangers that are attendant upon defective workmanship where welded plates are subject to pressure.

Firebox repairs are closely related to flue-welding and are being made with equal success. They include cracks in the side, tube, door and crown sheets, leaky staybolts, seams, etc. Patches may be put on when the sheets have become weakened so that repairs are impossible. The carbon electrode is ordinarily used to cut out the defective part and a new section is then welded in place. Half-side sheets, door sheets, etc., are welded in without difficulty.

Broken locomotive frames are very successfully repaired by the use of the electric arc. The great advantage in this work is the great speed that may be obtained, as no dismantling of the locomotive is necessary beyond that required to give the welder access to the broken parts. There are cases where frames have been welded without drawing the fire.

The actual cost of repairs made in a large railroad shop in the middle west is tabulated below, with the cost of the method previously used to secure the same results. In some instances replacement was the only method possible until the electric arc was used. The arc welding costs were based on a power cost of 51 cents an hour with the carbon electrode, and 17 cents with the metal electrode, together with the cost of labor and an overhead charge of 40 per cent.

	Cost of welding	Cost by other methods
Plugging 51 holes in expansion plate, holes 1 in. diameter by ½ in. deep	$2.75	$10.15
Repairing mud ring	6.50	34.57
Cutting four 6-in. holes in tender deck sheet ½ in. thick	1.08	8.35
Welding eccentric strap, broken through neck	1.08	41.28
Welding two spokes in driving wheel center	7.98	99.98
Welding cracks in side sheets	26.15	31.79
Repairing firebox	134.89	869.58
Building up flat spots on locomotive driver	.40	225.00

On the last item the large saving is due to the making of the repair at the roundhouse without withdrawing the locomotive from service, while any other method would require a week or 10 days' loss of time while the locomotive was shopped and the drivers turned down. If the loss of time be considered the cost of the older method might easily be $500 or more.

It has become universally accepted that a special motor-generator set gives the best results, because it supplies current of the necessary characteristics and does it at the lowest cost. The question that remains to be decided is the size of the set. Originally a separate set was supplied for each operator, but experience has proved that in a shop where two or more welders are employed it is better and cheaper to have one set supply several operators. Arc welding is necessarily an intermittent process, and hence the average load on the motor generator is low. Practice has shown that the arc will not be in use more than 50 per cent of the total time in most cases. This makes the cost of power higher than if the average load were nearer the capacity of the set.

Furthermore, the single set for several operators is cheaper to install than a set for each operator. The efficiency of the smaller set will of necessity be lower than that of the larger set. The general practice now is to install a motor-generator of sufficient capacity to supply all operators within a range of 500 to 600 ft. of the set with permanent wiring and outlet panels for the individual operators installed at the most convenient points where welding is to be done.

For miscellaneous repair work around large industrial plants a 300-ampere equipment, sufficient to allow two operators to work simultaneously with the metal electrodes, is usually satisfactory. Where more operators are employed for welding, and where carbon electrodes are used, it is usually desirable to put in a large set, though if the welding booths are scattered over a very wide area the use of several sets for two operators each may be found desirable. Individual consideration of the conditions must be made and the system best suited then installed.

*From an article by J. H. Bryan in the February, 1916, issue of The Boiler Maker.

CHISELS*

BY HENRY FOWLER
Chief Mechanical Engineer, Midland Railway

Very considerable attention has been given to the composition and treatment of tool-steel used in machine-tools, but the three implements of the hand worker—the file, the chisel, and the hammer—have been comparatively neglected. The author is aware of the work recently done in testing the former of these, and knows that there is little need of improvement with the last-named, but believes that the chisel has not received the systematic attention its importance deserves. A close examination of the new and used chisels in the shop over which he had control, confirmed that view.

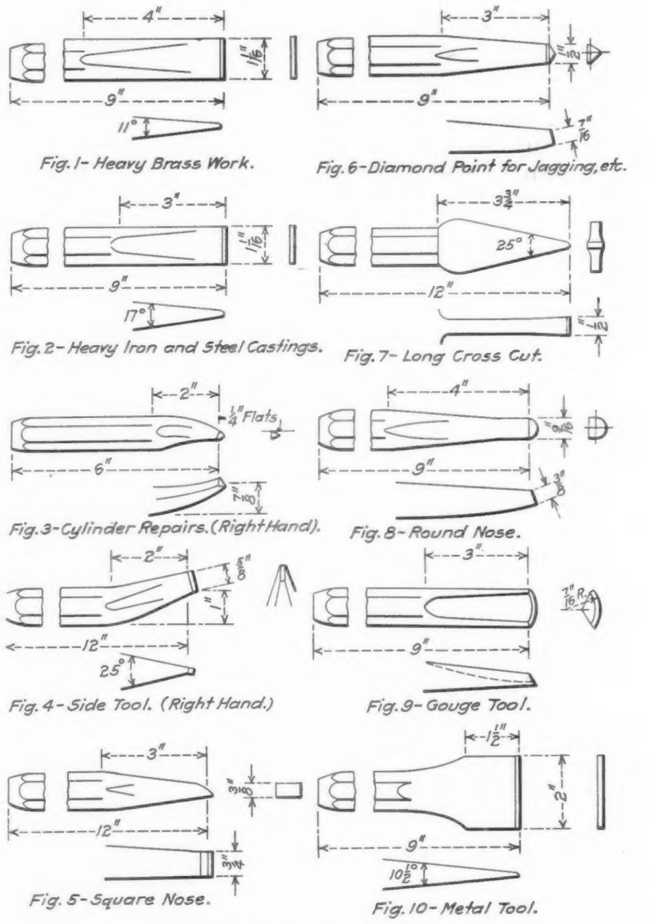


Chart of Standard Chisels

The material usually employed for chisels is not bought to specification, but a well-known and tried brand purchased. In the chief mechanical engineer's department of the Midland Railway, after considerable experiment it was decided to order chisel steel to the following specifications: "Carbon 0.75 per

*From a paper presented before the Institute of Mechanical Engineers on February 18, 1916.

cent to 0.85 per cent, the other constituents being normal." This gives a complete analysis as follows:

	Per cent
Carbon	0.75–0.85
Manganese	0.30
Silicon	0.10
Sulphur	0.025
Phosphorus	0.025

It is perhaps interesting to note that the analysis of a chisel which had given excellent service was as follows:

	Per cent
Carbon	0.75
Manganese	0.38
Silicon	0.16
Sulphur	0.028
Phosphorus	0.026

The heat treatment this chisel received is unknown.

At the same time that chisel steel was standardized, the form of the chisels themselves was revised, and a standard chart of these as used in the locomotive shops drawn up. Figs. 1 to 10 show the most important forms of these, which are made to stock orders in the smithy and forwarded to the heat-treatment room where the hardening and tempering is carried out on batches of fifty. A standard system of treatment is employed here which to a very large extent does away with the personal element. Since the chemical composition is more or less constant, the chief variant is the section, which causes the temperatures to be varied slightly. The chisels are carefully heated in a gas-fired furnace to a temperature of from 730 to 740 deg. C. (1346 to 1364 deg. F.) according to section. In practice the chisel, Fig. 1, is heated to 730 deg. C., chisel, Fig. 2, to 735 deg. C. (1355 deg. F.), and a 1-in. half round chisel to 740 deg. C., because of their varying increasing thickness of section at the points. Upon attaining this steady temperature, the chisels are quenched to a depth of 3/8 in. to 1/2 in. from the point in water, and then the whole chisel is immersed and cooled off in a tank containing linseed oil. This oil-tank is cooled by being immersed in a cold-water tank through which water is constantly circulated. After this treatment, the chisels have a dead hard point and a tough or sorbitic shaft. They are then tempered or the point "let down." This is done by immersing them in another oil-bath which has been raised to about 215 deg. C. (419 deg. F.). The first result is of course to drop the temperature of the oil, which is gradually raised to its initial point. On approaching this temperature the chisels are taken out about every 2 deg. C. rise and tested with a file, and at a point between 215 deg. C. and 220 deg. C. (428 deg. F.) it is found that the desired temper has been reached, the chisels are removed, cleaned in sawdust, and allowed to cool in an iron tray.

A question which naturally will be asked is whether comparative tests of these chisels with those bought and treated by the old rule-of-thumb methods have been made. It must be admitted that the author knows of no method of carrying out such tests mechanically, other than that of hardness by the Brinell or scleroscope method, while any ordinary test depends largely upon the dexterity of the operator. The universal opinion of foremen and those using the chisels of the advantages of the ones receiving the standard treatment set out has, however, convinced the author of the improvement made.

Questions may be raised as to why the chisels have not been normalized at about 900 deg. C. (1652 deg. F.) after forging and before hardening. This matter had attention when the question was first dealt with, but at that time there were no facilities for carrying out this work. These have since been provided in connection with certain other work, but although various chisels have been normalized in the manner mentioned, no advantage has been found in carrying this out.

EFFECT OF INSIDE LAP.—Addition of inside lap causes the exhaust to open later and to close earlier, with more compression and greater cushioning effect of the exhaust.—*Power*.

OPERATING A LARGE ENGINE TERMINAL*

BY F. W. SCHULTZ
District Foreman, Union Pacific, Grand Island, Neb.

A foreman who, through promotion, is placed in charge of a large and long-established engine terminal, regardless of facilities, does not have the job on his hands that a foreman has who takes charge, as an entire stranger, of some terminal where it is necessary to make an organization. Organization is a big study in itself, and it is a first-class organization that gets results. No matter how good a terminal may be as to facilities, it will not run itself. Supervision means a good deal, and plenty of it can be had in any organization. The best engine terminal organization is one in which when a man drops out for any cause he is immediately replaced by not only a good man but perhaps a better man. Understudies in all departments are necessary, and a live foreman should so know his organization as always to have a good man to promote. Develop an organization so that each department reports to the various heads, such as clerks to the chief clerk, foreman to the general foreman, helpers to their respective mechanics and hostler helpers to the hostlers. Where there are three fire builders, one should be the lead man; foreign laborers always work well together with a lead man. If only two blacksmiths are employed, one should be the lead man. It does not look well, and does not get results without causing friction, for a foreman to tell a hostler's helper to tell the hostler what he wants to do any more than it would look well for the general foreman to issue orders direct to an employee, ignoring his subordinate officer. If he desires to investigate a matter, or issue instructions personally, he should be considerate enough to take a subordinate officer with him. One man can handle no organization alone. He must have good subordinates, and by establishing such a system it will give the general head time enough to calmly think over matters and also take time to see for himself how things are going. Foremen should see what they can without asking too many questions. It is a poor time to investigate a piece of work after some irregularity has happened.

When two men are set to work on a piece of work at equal pay and are to be left alone any length of time, one man should be the lead man. When a man does a certain piece of work, he likes to know how well he has done it, and if a foreman finds a man's work is good he should say so. Nine times out of ten the man performing this piece of work will do the work quicker next time and try to do it better; therefore the foreman gets results.

Systematic promotion of men should be practised. Very often an employee with an intermediate rate of pay leaves the service. Some foremen have instructions not to fill such a vacancy. This is a mistake. Men who have not received this rate of pay are looking forward to this increase, and, when several men can be advanced, it increases the efficiency of the men because of their receiving encouragement and better pay. They usually begin at once to improve themselves for a still bigger job, which is getting results. An employee in any organization, who has a good idea, or discovers some irregularity and reports it to the foreman, should immediately receive commendation, and if his accomplishment is great enough to warrant it he should receive an increase, however small. Censure may do much, but encouragement does more.

Men in any organization appreciate clean, orderly and sanitary premises. This gets results by teaching order and cleanliness.

Modern locomotives which have outgrown a roundhouse are housed very often with part of the tender sticking out of the door, and at zero weather, or colder, this plays havoc with both men and equipment. Some enginehouses have a few stalls to accommodate part of the large power. A live foreman should see that his mechanics do not have to bundle

*Entered in the Enginehouse Competition which closed February 1.

up with so many clothes that they will be "clothes-bound," and should either put an engine in the house or leave it out. The greatest mistake a foreman can make is to do a day's work on an engine under such conditions without cutting off the tank, closing the doors, and showing his organization that he has their welfare at heart. Many a man has slighted a job, said mean things about a foreman and done a good deal to poison the rest of the organization, because the foreman has told him to put on some clothes to keep warm and go on back to work, forgetting that a man who is too heavily bundled up cannot handle any class of work effectively. Nowadays when there are seven or eight different nationalities employed in a large terminal employing 300 to 500, and repairing from 75 to 125 engines daily, a foreman must step into the plant as a diplomat and see that there is no friction. Employees in their various stations are continually looking to some man whom they consider above them, principally for their own welfare. If a foreman encourages them it spreads through the organization and gets untold results.

As regards facilities, there should always be two incoming tracks as well as two outgoing tracks to the turntable. Care must be taken not to mix the direction of traffic. Usually tracks can be placed on each side of the coal chute. If the roundhouse is too small, there should be enough storage tracks outside so as to accommodate the overflow. Any roundhouse can be well lighted, and if steam heat is not enough in pit pipes, stoves can be placed in the house. Up-to-date engine houses usually have heat enough from steam heating plants. There should be a vise and a work bench between every two stalls; also a small machine room adjacent to the roundhouse, centrally located, with proper machine tools and a few of the ordinary supplies which are used daily. It pays to put a man in charge of such a room and the tools, with instructions immediately to see that defective tools of any kind are repaired. Mechanics assigned to special work should be given special tools to be kept along with their private tools. A metal bench block riveted to the bench prevents the using of a vise as an anvil. The closer facilities are placed to the work, the less steps high priced labor will have to take. High priced mechanics required to push a truck instead of doing skilled work is labor misdirected.

An experienced foreman should know his various classes of power just as well as he should know each mechanic. Engine failures are avoided by knowing when to keep a weak engine off the road.

A foreman who is getting near the 100 per cent efficiency mark usually maintains a permanent organization, as no company or manager is going to disrupt any organization by requiring a reduction in force when results are nearly perfect. It should not be forgotten that regardless of facilities the one important matter is to make an organization and maintain it. The continued getting of results shows a stable organization and one that is handled properly. The best thing for any foreman to do in case he is not getting results is to investigate himself. He may be ever so conscientious, but he may need some experience; above all things, he should never allow prejudice or sentiment to enter into business.

ADVANTAGES OF POPPET VALVES.—The main advantages of poppet valves are that they have no wear from movement on their seats, and requiring no lubrication, they are better adapted to the use of superheated steam.—*Power.*

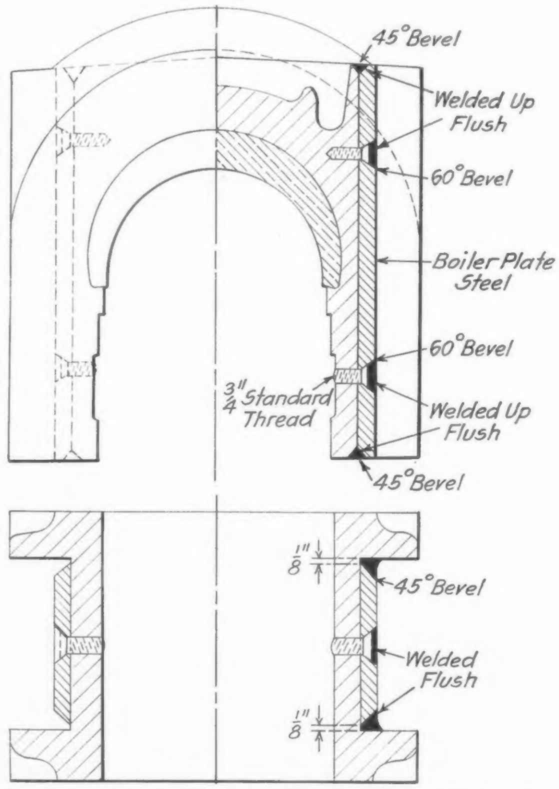
BOILER EXPLOSIONS.—The mechanism of a boiler explosion known as the Colburn Clark theory is as follows: An initial rupture; sudden, rapid reduction in pressure; the formation of a great quantity of steam in the water, hurling the water at the opening, increasing the latter and shattering the boiler; completion of vaporization of the liberated water, projecting the parts to distances depending on the violence of the expansion.—*Power.*

RECLAIMING DRIVING BOXES

BY R. P. PETERMANN
Tool Foreman, Atlantic Coast Line, Waycross, Ga.

The Atlantic Coast line has been increasing the life of driving boxes by placing brass liners on the shoe and wedge faces. The box is dovetailed and heated, and is then jacked open before the brass liner can be poured, which takes a great deal of time. In addition, it is possible to obtain only an average of one shopping out of brass liners as the metal is so soft that it either works loose or pounds out at the ends of the box.

The illustration shows a box with a steel boiler plate liner applied. With this method it is necessary to true up



Driving Box with Steel Plates on the Shoe and Wedge Faces

the box on a planer and plane the radius out of the corners so that the liner can be welded all the way up. This welding is done by an electric welder. The plates are pulled down solid by means of two countersunk 3/4 in. screws and the heads of the screws are welded to prevent their getting loose. This method of reclaiming driving boxes is a great deal cheaper than using the brass liners, and it is believed that it will result in at least twice the amount of service from the box.

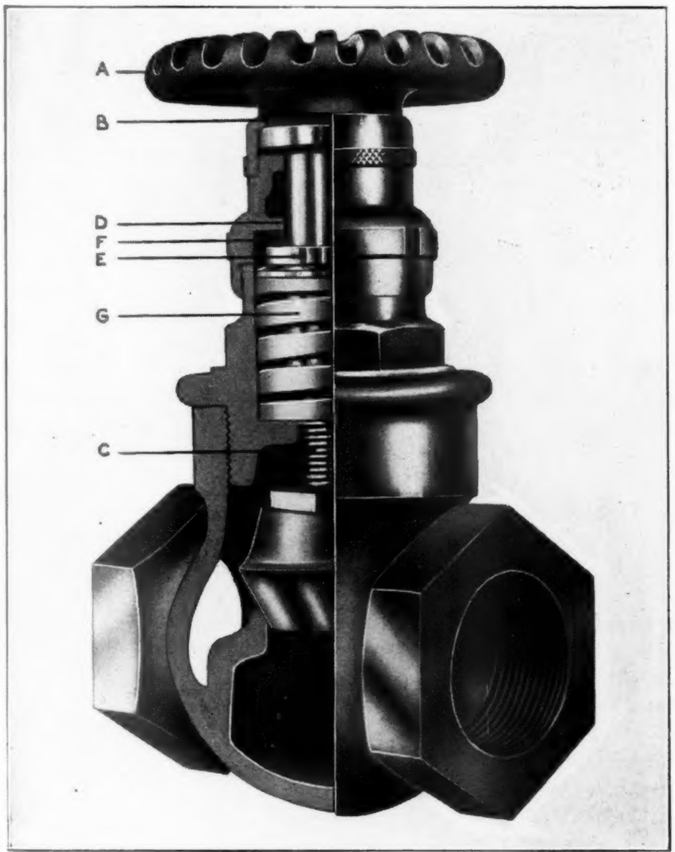
STOP-COCKS FOR BOILER PRESSURE GAGES.—The connection of a steam gage should be so arranged that the gage cannot be shut off from the boiler except by a cock placed near the gage, showing at a glance whether the cock is open or closed. To fill this requirement the cock should be provided with a tee or lever handle arranged to be parallel to the pipe in which it is located when the cock is open. —*Power.*

WETTING DOWN SLACK BEFORE FIRING.—Although moistening fuel detracts from its heat value, the loss is usually more than compensated by prevention of dust in handling and, especially where there is a strong or forced draft, wetting down will generally be of advantage to prevent fine fuel particles from being caught up by the draft and deposited on the heating surfaces of the boiler or swept out of the chimney unburned coal or ashes.—*Power.*

New Devices

UNIVERSAL NON-PACKING VALVE

According to the report of the chief inspector of locomotive boilers for the Interstate Commerce Commission 1,770 locomotives were found defective during the past fiscal year on account of leaking valves. This defect is principally due to improperly applied or worn packing in the stem of the valve. To eliminate trouble and defects of this sort, valves which require no fibrous packing have been developed by the Universal Valve Company, Karpen Bldg., Chicago. The construction of these valves is shown in the illustration. They are made up of a handle *A* which has a free fit on a



Universal Non-Packing Valve

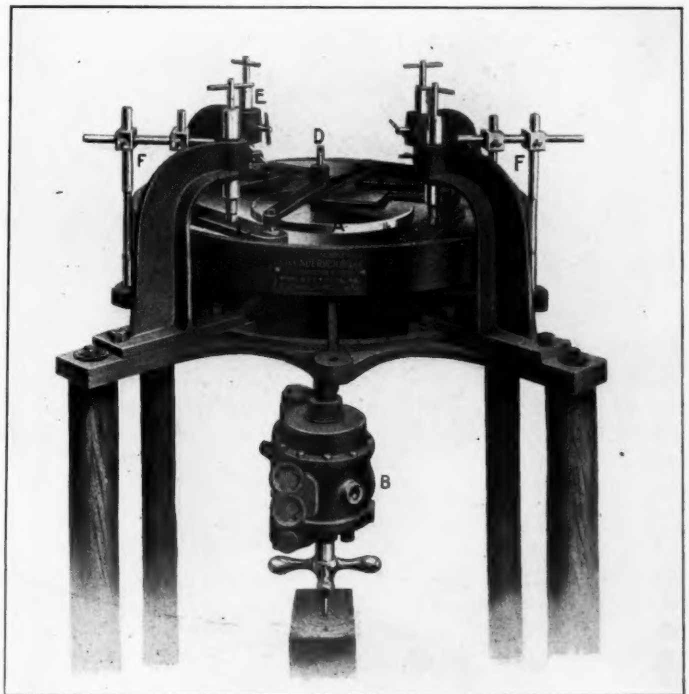
square shank of an auxiliary valve stem *D*. The handle is held in position by the collar *B* which is screwed onto the body of the bonnet. The auxiliary valve stem *D* is provided with a square socket to receive a square shank on the end of the main valve stem *C*. This member is threaded into the bonnet as indicated in the illustration and is raised or lowered as the handle is turned, a square socket in the auxiliary valve stem being sufficiently deep to always engage the shank of the main valve stem.

The shoulder *E* on the auxiliary stem is grooved on its upper surface and bears directly on the babbit ring *F* and is held in permanent contact with that ring by the cast-iron spring *G*. This forms a sufficiently tight joint with but little spring tension. It is guaranteed by the maker to last the life of the valve under high and low pressures and at temperatures ordinarily met with in the use of saturated and super-heated steam. The spring is made of cast-iron under the Knudsen patent, as this material has been found to better withstand high temperatures than a steel spring. In view of the construction of this valve it will withstand unusually hard service without its operation being affected. The company making this valve is in a position to make the entire valve or only the bonnet for application to valves of other makes. The composition of the babbit ring is varied to meet the temperature requirements. These valves have been in successful service on locomotives, high pressure steam plants, hydraulic systems and piping systems for the lighter gases such as oxygen, acetylene, etc.

MACHINE FOR GRINDING REFLEX WATER GLASSES

A machine for grinding reflex water glasses is being manufactured by H. B. Underwood & Company, Philadelphia, Pa.

It is simple in construction with very few wearing parts which are protected from coming in contact with the grinding material, thus avoiding unnecessary wearing of parts. The only part which is likely to require attention is the removable loose grinding disc, which can be redressed or replaced at little cost. The machine can be operated by unskilled labor and with cheap materials. It consists of a revolving table *A* to which motion is imparted by an air motor *B* running at 100 to 125 r. p. m., and four glass holders *C* which are given an oscillating motion by the pin *D* set eccentric with the table. This prevents the glass running in a concentric groove and avoids scratching or cutting it in ridges. The glasses are held under a flexible pressure, which can be regulated to the required amount by the pressure device *E*. The grinding compound is kept in contact with the glasses by two spreaders *F* placed diametrically opposite each other.



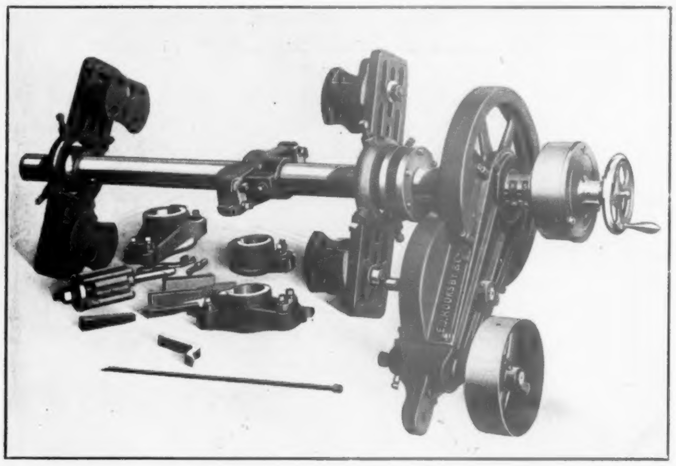
Reflex Water Glass Grinding Machine

BORING BAR FOR CYLINDER AND VALVE CHAMBER BUSHINGS

Safe guarding all moving parts of machine tools, both stationary and portable, has become not only desirable but, in many states, obligatory. In the new design of the Rooksby portable boring bar, the manufacturers have been guided by the "Safety First" principle and have carefully guarded all exposed gears and moving parts.

These machines are designed especially for reboring locomotive cylinders and valve chamber bushings. They can be used with one or both cylinder heads removed and are easily and quickly set up. The crosshead blocks are bolted to the cylinder with the cylinder head studs and the bar revolves in the sleeves supported and centered by set screws in the crossheads. When boring with only one head removed, the expanding chuck and pin, having five sets of taper gibs to fit in stuffing boxes of various diameters, is used to support the crank end of the bar.

The power is applied to the bar by means of a back geared driving power having a two speed quick change gear drive. This is a recent improvement and is of particular advantage where the same bar is used to rebore cylinders and valve chamber bushings of various sizes. The quick change is accomplished by simply pulling out a slip pin,



Portable Boring Bar for Cylinders and Valve Chambers

shifting the primary pinion out of gear and driving by the intermediate shaft. There has also been designed an improved tool holder using high speed cutters for extra hard service. The cutter head is fed by means of an automatic feed case having two changes of feed controlled by a slip pin. This is also completely encased as shown in the engraving.

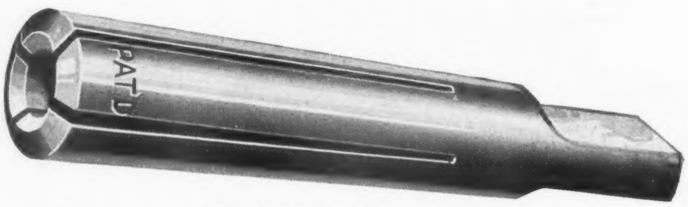
For setting the bar up in valve chamber bushings, a novel device is used enabling the operation to be quickly and accurately performed. This consists of a set of taper cone sleeves in halves, fitting in the counterbore, supporting the bar in a central position while the blocks and crossheads are being bolted up, after which the cones are removed and the bar is ready for reboring. The sleeves being taper, one set can be used in bushings of various sizes within their range.

These portable boring bars are manufactured by E. J. Rooksby & Company, 431-439 N. 11th St., Philadelphia, Pa.

MANGANESE STEEL.—This steel has the peculiar property of being toughened and softened by quenching in water, resembling copper in this respect. All manganese steel castings are subjected to this treatment to remove brittleness. It has found its principal application in castings for crushing and grinding machinery and railroad crossings.

CHUCK FOR DRIVING TAPS

Considerable trouble is experienced with the ordinary methods of driving taps in getting them to run true. This is detrimental both to the quality of the work and the life of the tap and is due to the fact that the shanks and squares of the taps vary considerably in size. These variations have made it very difficult to secure uniformly satisfactory operation with the type of holders generally used. A simple tap chuck for use in the drill press spindle, which is designed to overcome this difficulty, is shown in the drawing. This device is known as the True Drive tap chuck and has recently been placed on the market by Scully-Jones & Co., Chicago.



Simple Tap Driving Chuck

The chuck is made in one piece, the body being split into four segments for a distance of from two to four inches from its lower end. The square head of the tap is placed in the socket of the chuck, and as the latter is driven up into the Morse taper socket of the drill spindle, the segments of the chuck are tightly closed against the head of the tap. The chuck socket is of square section to correspond with the square of the tap, thus providing for a positive transmission of the drive. The chuck is of hardened steel, and this, together with the manner in which it is used, are claimed to make it almost indestructible.

MOORE TYPE REFRIGERATOR AND HEATER CAR

The Moore type of car is designed to meet the requirements for the transportation of perishable freight under all weather conditions. It is a combination refrigerator, ventilator and heater car. Its general construction is the same as that of any refrigerator car with the substitution of a live air space about $1\frac{1}{2}$ in. wide in the sides, ends, floor and ceiling of the car in place of the usual dead air space. This space is connected to the interior of the car by a $\frac{3}{4}$-in. slot in the inner lining located about 4 in. above the floor, and to the ice box at the top of the car, as shown in the illustrations. The purpose of this live air space is to assist in the matter of circulation and to completely surround the contents of the car with a wall of cold or warm air, according to whether it is used as a refrigerator or a heater car. The interesting feature in the arrangement of the Moore system is the means employed to secure a positive and active circulation of air throughout the entire car, no matter in which service it is used.

The ice box is located in the center of the car directly under the roof. It is substantially supported by T-beams and is loaded through six hatchways in the roof. The ice box has three openings into the car, one at each end and one in the center. Through the opening in the center the cold air is discharged into the car, as indicated by the arrows in Fig. 1. The cold air falls to the floor and tends to spread out over the bottom of the car towards each end. The warm air rises and enters the ice box through a netting at the end where it is cooled and again passes through the opening in the center of the ice box into the car chamber. The cold air is also drawn into the live air space through the opening in the sides and ends of the car by the rising warm air which passes through this space to the ice box, where it is again cooled and discharged through the middle opening of the ice box. Tests made with this type of car under refrigeration show

that an even temperature is obtained throughout the entire car. This positive circulation not only gives the proper refrigeration but has a drying effect, which is of decided advantage when perishable freight is being transported. The dampness, being taken up by the warm air, is carried to the ice box and there condensed and deposited on the ice, where it is washed away with the drippings from the ice box. There are four drains which carry away the melted ice, two being located on each side of the car and discharging underneath the car well outside of the tracks and away from the trucks.

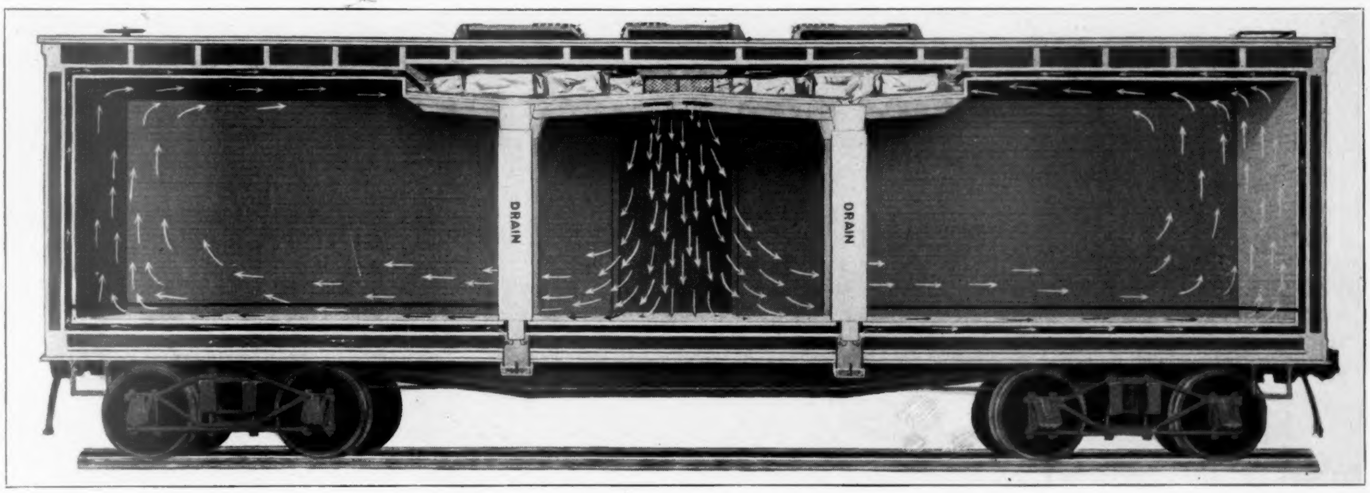


Fig. 1. Moore Type Car in Use for Refrigeration

There is no opportunity for the water from the melted ice to cause rotting and corrosion.

The accompanying table, which is a report of a test made on one of these cars, illustrates the even temperature maintained throughout the car while under refrigeration.

	Floor Front.	Floor Center.	Top Fruit Center.	Floor Rear.	Outside Temp.
Friday, 11:00 a. m.	64	64	64	64	82
Friday, 6:00 p. m.	62	62	62	62	78
Saturday, 7:30 a. m.	62	62	60	60	68
Saturday, 5:15 p. m.	64	62	62	64	76
Sunday, 11:05 a. m.	64	64	64	64	78
Monday, 6:00 a. m.	70	70	70	70	74

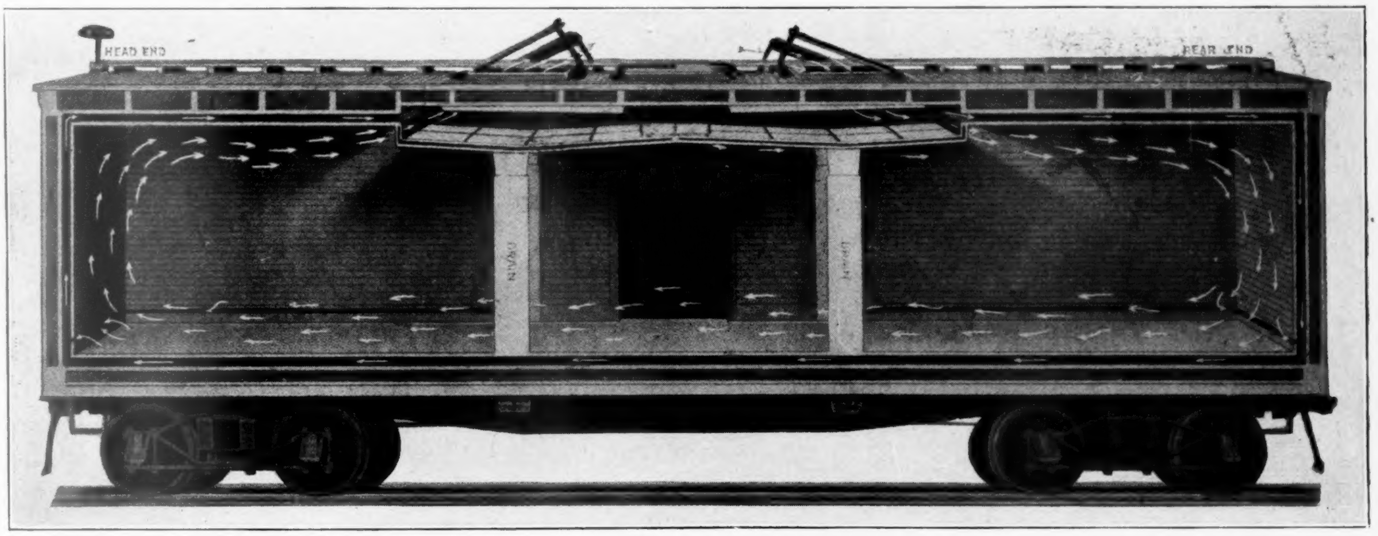


Fig. 2. Moore Type Car Under Ventilation

This car was loaded with 320 bunches of bananas, the temperature of the fruit when placed in the car being about 64 deg. A high temperature is required for banana service. To obtain the desired temperatures in this test refrigeration and ventilation were used at the same time, all plugs being out and all vents being partly open. The car was sent from New York to Toledo, Ohio. Throughout the trip it passed through temperatures as high as 110 deg. in the sun and 96 deg. in the shade. The temperature record at the top of the fruit is especially noteworthy, as it was only 3 ft. from the ice box. It was also stated in the report of this test that throughout the test the fruit did not show any sign of moisture to the extent that usually is shown on refrigerated fruit due to condensation. This undoubtedly is due to the good circulation obtained in the car. Comparative tests with the end ice box cars have shown that the Moore cars consume from 50 to 60 per cent less ice under the same conditions, due to the fact that with good circulation less ice is required.

The ice tanks, being built directly under the roof of the car, do not occupy valuable space, as do the ice boxes in refrigerator cars equipped with end ice boxes. By this means it is possible to carry from 20 to 25 per cent more freight in a Moore car than in an end ice box car of the same dimensions. The rigid construction of the ice box also provides a valuable reinforcement to the superstructure of the car. A possible objection might be raised due to the raising of the center of gravity of the car by placing the ice in such a high position, but it has been calculated that this figure will not be increased materially, it varying from one to two inches higher than refrigerator cars using the end ice box system.

When this type of car is used as a ventilator car the front and rear hatches are raised to an inclined position, the rear hatches being open to the direction of travel and the forward hatches away from the direction of travel. The air passes into the car through the rear hatches, passing down into the

ice box and into the car itself through the grating at the rear end of the ice box. The tendency is for this air to pass along the ceiling to the end, thence downward, back along the floor to the front end and out through the forward hatches, the suction caused by the outer air passing over these hatches assisting to remove the air from the inside of the car. The action of the air when the car is used in this service is well shown by the arrows in Fig. 2. Records of the temperature taken with one of these cars under ventilation loaded with 317 bunches of bananas show the same uniformity of temperature as was obtained when the car was running as a refrigerator car. The following table gives the temperatures at various parts of the car on a shipment from New York City to Dunkirk, N. Y.:

	Ceiling.	Floor Front.	Floor Center.	Top Fruit Center.	Floor Rear.	Outside Temp.
Friday, 11:00 a. m.....	74	64	64	62	64	76
Friday, 7:00 p. m......	68	60	60	60	60	74
Saturday, 7:00 a. m....	64	60	60	60	60	66
Saturday, 4:30 p. m....	70	66	64	66	68	74
Sunday, 10:30 a. m.....	68	66	64	66	66	66

On arrival the fruit was green and cool. In the report of these tests it was stated that although this was not as severe a test as could have been made, the results show that the Moore system of ventilation is to be considered superior to the end system of ventilation. Bananas are a difficult product to transport without deterioration.

When the car is to be used to carry perishable freight under heat a coal stove is provided, as shown in Fig. 3. It is carried in an insulated box located under the car at the side near the door, and is operated entirely from the outside. It heats the fresh air taken from an intake located directly beneath the stove. This air surrounds the stove and chimney, passing up through the heating drum, and enters the car near the top, displacing the colder air, forcing it down through the live air space and off the floor of the car into the live air space under the floor, where it passes into the heater box whence part of it goes out through the waste air pipe which is connected to the chimney and part is reheated and passed back into the car. The arrows in Fig. 3 show the action of the circulation of the air in the car. The stove used for

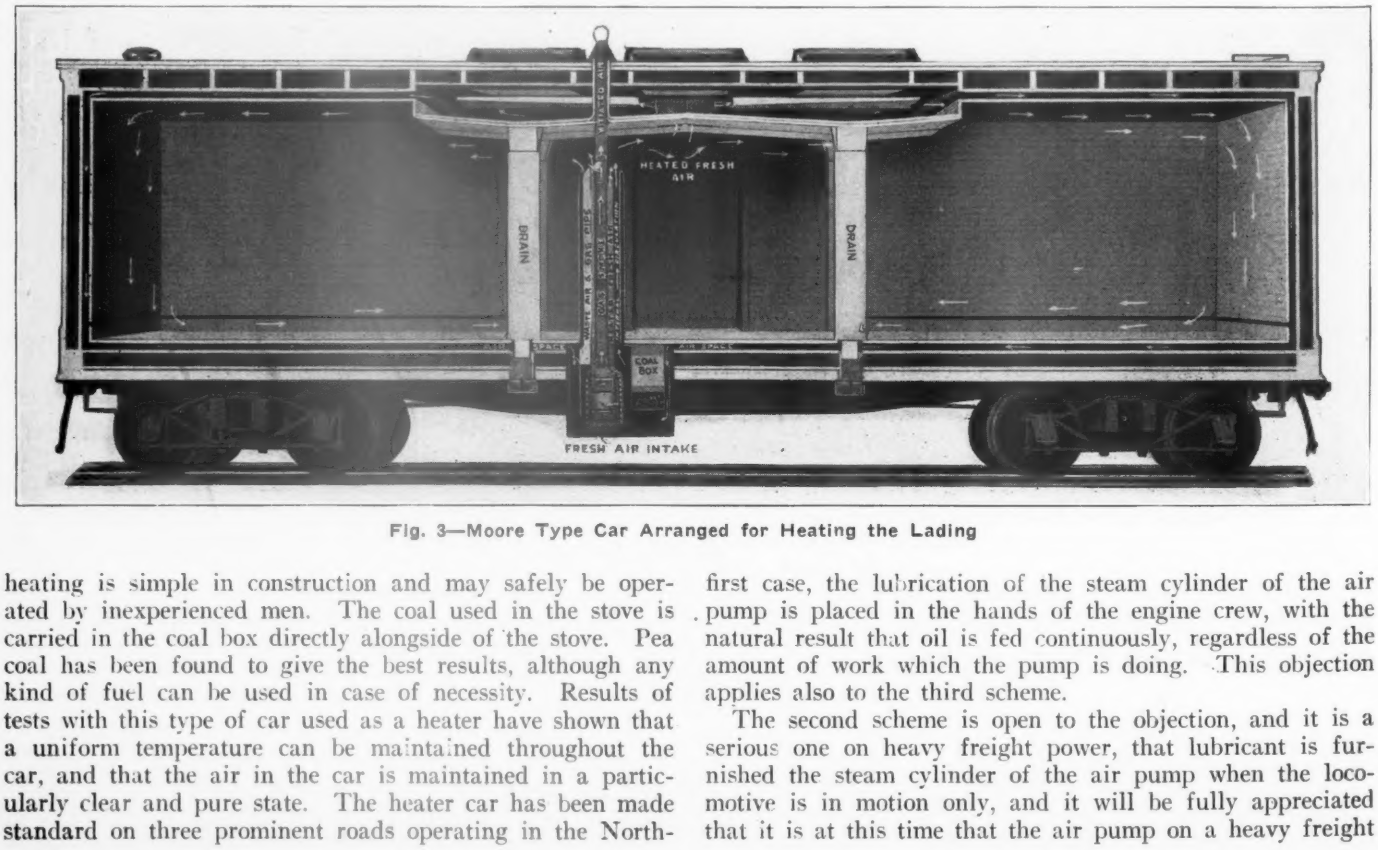


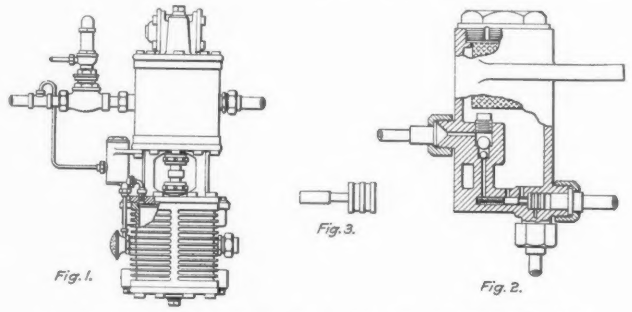
Fig. 3—Moore Type Car Arranged for Heating the Lading

heating is simple in construction and may safely be operated by inexperienced men. The coal used in the stove is carried in the coal box directly alongside of the stove. Pea coal has been found to give the best results, although any kind of fuel can be used in case of necessity. Results of tests with this type of car used as a heater have shown that a uniform temperature can be maintained throughout the car, and that the air in the car is maintained in a particularly clear and pure state. The heater car has been made standard on three prominent roads operating in the Northwest, and it has been found entirely adequate to handle perishable freight in the coldest weather. The rights for the use of this car are now controlled by the Refrigerator, Heater & Ventilator Car Company, St. Paul, Minn.

LUBRICATOR FOR LOCOMOTIVE AIR PUMPS

The subject of locomotive air pump lubrication is one which has not been given a great deal of consideration by the mechanical departments of most of the railroads of this country. The lubrication of the steam cylinder is usually taken care of in one of three ways:

Where locomotives are equipped with hydrostatic lubricators for lubricating the engine cylinders, an additional



Air Pump Lubricator for Both Air and Steam Cylinders

feed is supplied on the lubricator and connected to the steam cylinder of the air pump;

Where locomotives are equipped with force-feed lubricators for lubricating the engine cylinders, an additional pump is supplied for furnishing lubrication to the steam cylinder of the air pump;

In some instances a separate single feed hydrostatic lubricator is applied to the locomotive.

None of these schemes is entirely satisfactory, as, in the first case, the lubrication of the steam cylinder of the air pump is placed in the hands of the engine crew, with the natural result that oil is fed continuously, regardless of the amount of work which the pump is doing. This objection applies also to the third scheme.

The second scheme is open to the objection, and it is a serious one on heavy freight power, that lubricant is furnished the steam cylinder of the air pump when the locomotive is in motion only, and it will be fully appreciated that it is at this time that the air pump on a heavy freight

locomotive requires the least amount of lubrication. When a locomotive so equipped makes a stop with a long train the air pump is usually required to make several hundred strokes in recharging the train line, during which time it will in many cases become so dry as to interfere seriously with its operation and efficiency.

The lubrication of the air cylinders of locomotive air pumps is generally taken care of even more inadequately than is the lubrication of the steam cylinders. Neither the hydrostatic lubricator nor the ordinary force-feed lubricator is a satisfactory device with which to lubricate the air cylinders, as in either case the oil is introduced in amounts in excess of what is required, and in a form which is not best suited to the lubrication of the hot dry cylinder walls and the valves. It is the practice generally to introduce oil into the air cylinders through what is commonly known as an oil cock applied to the top head. With this arrangement someone is depended upon to fill the cup with oil, open the cock and allow it to flow down into the cylinder when the pump is not in operation. This method is not conducive to good results on account of the fact that as a general proposition oil is not applied until indications of its need are observed; also on account of the fact that when oil is introduced it is in such quantities and in such form as to carbonize on the walls of the cylinder and to gum up the discharge valves. Further, the lack of facilities for properly lubricating the air cylinder leads to the objectionable practice of pouring oil on the outside of the intake strainer, which tends to gum it up, causing dirt to collect in such quantities as to restrict the free passage of air through the intake, and interfering with the capacity and efficiency of the pump.

With the view of overcoming these difficulties and furnishing lubrication to air pumps in proportion to the amount of work done, the lubricator illustrated has been designed by O. C. Wright, assistant engineer of motive power, Pennsylvania Line, Fort Wayne, Ind., and patents applied for. Fig. 1 shows the lubricator as applied to a Westinghouse 9½ in. air pump. Fig. 2 shows a section through the operating parts of the lubricator; Fig. 3 shows the operating member of the lubricator in detail.

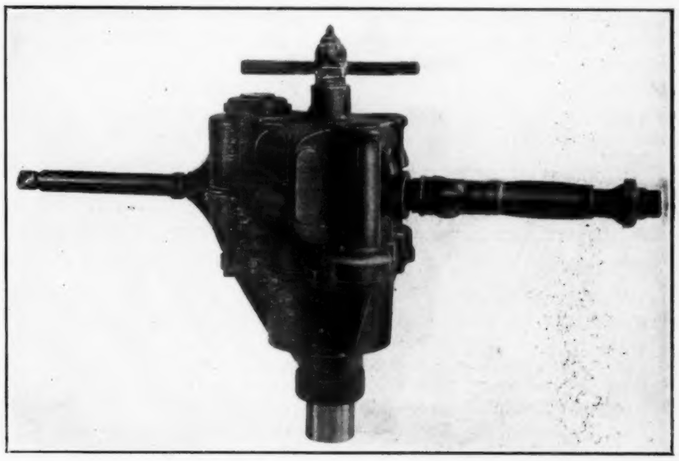
Referring to Fig. 1, it will be noted that three connections are made to the lubricator. No. *15* leads to the pipe supplying steam to the steam cylinder; *12* to the top head of the air cylinder, and *14* to the air inlet of the air cylinder.

Referring to Fig. 2, it will be noted that connection *12*, being made to one end of the air cylinder, provides a means for creating alternate vacuum and pressure in the cavity *P*, which produces a reciprocating motion of the operating member; in other words, one cycle of the air pump produces a complete stroke forward and back of the operating member. In the backward stroke a quantity of oil is drawn from the cup *L*, through the port *V*, into chamber *Q*, a part of which on the forward stroke is forced through the passage *Y*, past the double ball check valves *5* and *6*, into the connection *15*, and thence to the steam supply pipe of the steam cylinder. Simultaneously with this operation on the back stroke of the operating member a small quantity of oil is drawn from the cup *L*, through the port *U*, into the chamber *P*, and on the forward stroke part of the oil is forced through port *S* into connection *14*, thence through the air inlet past the inlet valves and into the air cylinder. This oil enters the cylinder in an atomized state on account of its mixture with air during its ejection from chamber *P*. From the foregoing it will be noted that on each stroke of the pump a quantity of lubricant is supplied to both the steam and air cylinders, which quantity can be regulated by the proper proportioning of the ports *U* and *V* and locatthem with proper relation to the limits of travel of the operating member. It will be noted from Fig. 1 that the bolting flange *J*, Fig. 2, is attached to the lower steam cylinder head, which not only serves as a convenient method of supporting the lubricator, but also affords a means of conducting heat from the steam cylinder, maintaining the oil in the lubricator at practically constant temperature under all weather conditions.

It is believed that the application of this device will be found to result in not only a reduction in the amount of oil used and the number of train detentions on account of air pump failures, but also in an appreciable reduction in the cost of maintaining the pumps.

COMPOUND-GEARED PNEUMATIC DRILL

An exceptionally powerful, compound geared pneumatic drill motor has recently been brought out by the Ingersoll-Rand Company, 11 Broadway, New York,. This drill is reversible and is designed to handle the heaviest flue rolling, drilling, reaming and tapping. It is particularly adapted to tapping operations on flexible stay bolt work, running-in stay bolt sleeves, locomotive valve setting, and other heavy duty operations. The construction is such that it develops full power on the reverse as well as the forward motion. This is of particular advantage in applying flexible stay bolt sleeves as, after the sleeve has been set up tight, it is possible to unscrew the sleeve cap by reversing the motor. This obviates the necessity for the usual cumbersome wrench.



Heavy Duty Compound-Geared Drill Motor

In setting locomotive valves this motor has the same advantage in that it will revolve the drivers in either direction with equal facility.

The motor has the one piece, gear timed valves, the ball and roller bearing crank shaft and connecting rods, and is generally similar in construction to the other pneumatic drills built by the same manufacturer. It is ordinarily furnished with a No. 5 Morse taper socket and operates at a free spindle speed of 100 r.p.m.

Oxygen Tests.—The only positive way to test the comparative value of electrolytic and liquefaction oxygen is by a practical laboratory test using a gas-bell and meter, cutting metals that are identical and using the same torch for all tests. This will give the relative oxidizing effects pressure and costs.—*The Welding Engineer.*

Boiler Tubes Split in Beading.—When tube ends become split from beading they may not have been properly annealed, the beading may not have been done gradually around the tube, or before any beading was done the tube ends may have projected too far beyond the tube sheet to be turned over without splitting.—*Power.*

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WE GUARANTEE, that of this issue 8,300 copies were printed; that of these 8,300 copies 7,238 were mailed to regular paid subscribers, 125 were provided for counter and news companies' sales, 391 were mailed to advertisers, exchanges and correspondents, and 546 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 31,700, an average of 7,925 copies a month.

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VOLUME 90 APRIL, 1916 NUMBER 4

CONTENTS

NEWS DEPARTMENT

CORRECTION

In the article on the design of Hollow crank pins in the February number, there was an error in equation (6), on page 67. This equation should read $D_o = 8 \sqrt[3]{\frac{P^1 L^1}{15 \pi S}}$ where S is the allowable fiber stress of the material. As the formula is printed s is the stroke used in finding P. The same error occurs directly below, where the formula should read, D_s = diameter of a solid pin $= \sqrt[3]{\frac{32 PL}{\pi S}}$.

JOHN SCOTT LEGACY MEDAL AWARDED TO CLEMENT F. STREET

The city of Philadelphia, acting on the recommendation of the Franklin Institute, has awarded the John Scott Legacy Medal and Premium to Clement F. Street, vice-president of the Locomotive Stoker Company, for the Street locomotive stoker. About 100 years ago John Scott, a chemist and metallurgist of Edinburgh, left to Philadelphia a large sum of money, the interest on which is used for the encouragement of "ingenious men and women who make useful inventions." The legacy also provides for the distribution of a medal inscribed "To the Most Deserving," and a money premium to persons whose inventions shall merit it.

Clement F. Street

Mr. Street was at one time mechanical editor and manager of the Railway and Engineering Review, now the Railway Review. He was later associated with the Dayton Malleable Iron Company for nine years, engaging in the designing and selling of railway supplies; with the Wellman, Seaver, Morgan Company, and the Westinghouse Electric & Manufacturing Company. He began development work on the stoker that bears his name in November, 1907, the first machine being put in service on a Lake Shore & Michigan Southern locomotive in May, 1909. There are now 1,000 Street stokers in service and on order.

In accepting the award of the Medal and Premium, Mr. Street expressed his high appreciation of the honor which had been conferred upon him by the Franklin Institute. He took occasion to give full credit to his assistants who had helped him perfect the stoker. He also made the statement that Herman H. Westinghouse, president of the Westinghouse Air Brake Company, was the man who really made the Street stoker a success, and added that had it not been for the financial backing which he secured and, equally important, the moral support he gave it and the men who were developing it, the machine would not be where it is today.

EQUIPMENT ORDERS IN MARCH

The heavy buying of cars and locomotives continued during the month of March. The sales during the last week of the month were especially large, orders having been reported during the week for 128 locomotives, 4,250 freight cars and 98 passenger cars. Orders so far reported this year to date compare with orders during the same period of 1915 as follows: Locomotives, 1,137 as compared with 181 in 1915; freight cars, 38,189 as against 8,943, and passenger cars, 535 as compared with 696. The orders for March were as follows:

	Locomotives	Freight Cars	Passenger Cars
Domestic	368	9,050	146
Foreign	41	75	24
	409	9,125	170

The important locomotive orders included the following:

Road	No.	Type	Builder
Atlantic Coast Line	10	Pacific	Baldwin
	2	Switch	Baldwin
Chicago & North Western	28	Switch	American
	14	Pacific	American
	35	Mikado	American
Great Northern	25	Mikado	Baldwin
Missouri Pacific	20	Mikado	American
	6	Switch	American
Pennsylvania Lines West	25	Mikado	Lima
	25	Mikado	Baldwin
St. Louis & San Francisco	30	Santa Fe	Baldwin
Central of Brazil	15	Consolidation	American
	3	Mallet	American
Java State Railways	8	Mallet	American

The freight car orders included the following:

Atlantic Coast Line	500	Box	Barney & Smith
	300	Flat	Barney & Smith
Chicago, Burlington & Quincy	500	Automobile	Amer. Car & Fdy.
Erie	1,000	Dump	Standard Steel
Great Northern	500	Refrigerator	Haskell & Barker
New York Central	1,000	Box	Amer. Car & Fdy.
	1,000	Coal	Standard Steel
Philadelphia & Reading	500	Hopper	Standard Steel
	500	Hopper	Pressed Steel
Southern	1,000	Gondola	Pressed Steel
	500	Gondola	Mount Vernon
Union Tank Line	750	Tank	Amer. Car & Fdy.

Nearly all the passenger cars ordered were included in two orders, those for the Atlantic Coast Line and the Illinois Central, respectively. The Atlantic Coast Line order was for 22 cars placed with the Pullman Company, including 6 baggage, 4 baggage and mail and 2 passenger and baggage cars and 10 coaches. The Illinois Central order included 1 postal and 9 mail and baggage cars ordered from the American Car & Foundry Company, and 18 baggage, 45 coaches, 10 dining, 4 buffet and 7 chair cars ordered from the Pullman Company. The foreign order for 24 passenger cars, the first large order for passenger cars for export reported for some time, was for passenger train cars for the Chilean State Railways ordered from the Osgood-Bradley Car Company.

MEETINGS AND CONVENTIONS

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—The fourth annual convention of the Railroad Master Tinners', Coppersmiths' and Pipefitters' Association will be held at the Hotel Sherman, Chicago, on May 22-24.

International Railway General Foremen's Association.—The annual convention of the International Railway General Foremen's Association will be held on August 29-September 1, at the Hotel Sherman, Chicago. The following is the list of topics to be considered at this meeting: Car Department Problems, E. E. Griest, chairman; Counterbalancing the Locomotive and Fitting Up Frames and Binders, H. C. Warner, chairman; Classification of Repairs, Robert Wilson, chairman; Relation of the Foreman to the Men, T. E. Freeman, chairman.

Master Blacksmiths' Association.—The twenty-fourth annual convention of the International Railroad Master Blacksmiths' Association will be held at the Hotel Sherman, Chicago, August 15-17, 1916. The following subjects will be discussed: Frame Making and Repairing, Drop Forgings, Tools and Formers, Spring Making and Repairing, Frogs and Crossings, Carbon and High Speed Steels, Case Hardening, Oxy-Acetylene and Electric Welding, Shop Kinks, Heat Treatment of Metals, Piece Work and Other Methods, Reclaiming of Scrap Material, Flue Welding.

Railway Storekeepers' Association.—The thirteenth annual convention of the Railway Storekeepers' Association will be held on May 15-17, at the Hotel Statler, Detroit, Mich. The following subjects will be discussed: Dismantling of Cars; Standard Push Poles, Tool Handles, Jack Handles, Brake Clubs, etc.; Handling of Company Material, L. C. L. or otherwise, to Conserve Use of Cars; Filing Correspondence; Recommended Practices; Accounting; Piece Work; Standardization of Tinware; Stationery; Lumber; Ties; Rails; Scrap and Scrap Classification; Standard Buildings and Structures; Book of Standard Rules; Marking of Couplers and Parts; Reclamation.

Master Car & Locomotive Painters' Association.—The next annual convention of the Master Car and Locomotive Painters' Association will be held at Atlantic City, N. J., on September 12-14, 1916. The list of subjects to be presented is as follows: The Initial Treatment and Maintenance of Steel Passenger Equipment Roofs, etc.; Headlinings Painted White or in Very Light Shades—How Should They Be Treated and Should They Be Varnished; Is It Economy to Purchase Paints Made on Railroad Specifications; The Shopping of Passenger Cars for Classified Repairs; Railway Legislation and Its Effect on Business. The following questions will also be discussed: To what extent is it necessary to remove trimmings from passenger car equipment undergoing paint shop treatment? How

RAILROAD CLUB MEETINGS

Club.	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Apr. 11	The Railways of India	S. J. Sarjant	James Powell	St. Lambert, Que.
Central	May 11			Harry D. Vought	95 Liberty St., New York
Cincinnati	May 9			H. Boutet	101 Carew Bldg., Cincinnati, O.
New England	Apr. 11	Preparedness	I. A. Droege	Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Apr. 21	Passenger Car Sanitation	Thos. R. Crowder	Harry D. Vought	95 Liberty St., New York
Pittsburgh	Apr. 21	Locomotive Inspection Laws and Rules.	F. McManamy	J. B. Anderson	207 Penn Station, Pittsburgh, Pa.
Richmond	Apr. 10	Efficiency and the Supply Department	H. C. Pearce	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Apr. 14.			B. W. Frauenthal	Union Station, St. Louis, Mo.
South'n & S'w'rn	Apr. 20			A. J. Merrill	Box 1205, Atlanta, Ga.
Western	Apr. 18			Jos. W. Taylor	1112 Karpen Bldg., Chicago.

does the hot water and oil method of cleaning locomotives at roundhouses affect the painted parts? Is there any advantage in painting or oiling the interior of new or old steel gondola and hopper cars? Is there anything superior to varnish remover for removing paint from a steel passenger car, considering labor and material costs? Is there anything superior to soap for the cleaning of passenger equipment cars preparatory to painting and varnishing?

Central Railway Club.—The principal speaker at the annual dinner of the Central Railway Club held at the Hotel Statler, Buffalo, N. Y., Thursday evening, March 9, was John J. McInerney, of Rochester, general counsel of the New York State Motor Federation. Mr. McInerney spoke on "Preparedness of Men to Eenter the Railroad Service and the Possibilities of Advancement in the Service." He maintained that railway men were not properly "prepared," that no one of our great colleges trained men for practical railway service, and that, in consequence, there was clearly need for training schools or colleges for railway men.

The other speakers were W. L. Conwell, assistant to the president of the Safety Car Heating & Lighting Company, and John D. Wells, editor of the Buffalo News. Frank Hedley, vice-president and general manager of the Interborough Rapid Transit Company, of New York, was toastmaster.

One of the features of the evening was the testimonial accorded Harry Vought who, for 25 years, has held an official relationship with the club, two years as assistant secretary and treasurer and 23 as secretary and treasurer. Mr. Vought was presented with a purse of gold and was later arraigned on an indictment offered by B. A. Hegeman, Jr., president of the United States Metal & Manufacturing Company, and D. W. Pye, president of the Transportation Utilities Company. He had to plead to a long list of charges, after which Toastmaster Hedley, as judge, passed judgment upon his case and presented him with a roll of bank notes on behalf of the New York delegation.

The dinner was considered the most successful yet held. There were 265 ladies and gentlemen present, of which 67 were from New York, 47 of the New York delegation having come to Buffalo on three special cars.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 2-5, 1916, Hotel Ansley, Atlanta, Ga.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—W. E. Jones, C. & N. W., 3814 Fulton St., Chicago. Convention, May 22-24, Hotel Sherman, Chicago.

American Railway Master Mechanics' Association.—J. W. Taylor, Karpen Building, Chicago. Convention, June 19, 1916, Atlantic City, N. J.

American Railway Tool Foremen's Association.—Owen D. Kinsey, Illinois Central, Chicago. Convention, August 24-26, 1916.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Convention, June 27-July 1, Traymore Hotel, Atlantic City, N. J.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except July and August, Hotel La Salle, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, Albany, N. Y. Convention, October 3-5, Indianapolis, Ind.

International Railway Fuel Association.—J. G. Crawford, 547 W. Jackson Blvd., Chicago. Convention, May 15-18, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1126 W. Broadway, Winona, Minn. Convention, August 29-31, 1916, Hotel Sherman, Chicago.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio. Convention, August 15, 1916, Hotel Sherman, Chicago.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention, May 23-26, 1916, Hollenden Hotel, Cleveland, Ohio.

Master Car Builders' Association.—J. W. Taylor, Karpen Building, Chicago. Convention, June 14, 1916, Atlantic City, N. J.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention, September 12-14, 1916, "The Breakers," Atlantic City, N. J.

Niagara Frontier Car Men's Association.—E. Frankenberger, 623 Brisbane Building, Buffalo, N. Y. Meetings monthly.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention, May 15-17, 1916, Hotel Statler, Detroit, Mich.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Convention, September, 1916, Chicago.

PERSONAL

GENERAL

Elmer A. Borell, general air brake inspector of the Philadelphia & Reading, has been appointed engineer of motive power, with office at Reading, Pa., and the position of general air brake inspector has been abolished.

John P. Risque has been appointed mechanical engineer of the United Railways of Havana at Cienaga, Havana. Mr. Risque was born in 1880 at Silver City, New Mexico. After finishing a manual training course at Washington University, St. Louis, Mo., in 1897, he joined the staff of the *Railway Age* in Chicago, Ill. In 1899 he entered the shops of the Atchison, Topeka & Santa Fe at Topeka, Kan., as a machinist apprentice, and in 1903 went to the Mexican Central as a machinist at Mexico City, where he later became general foreman of the main shops at Aguas Calientes. He left the Mexican Central in 1905 to accept a position with the Minneapolis, St. Paul & Sault Ste. Marie at Minneapolis, Minn., leaving there in 1907 to go into the manufacturing business for himself. He remained in this work until recently, when he again entered the railway field as mechanical engineer of the United Railways of Havana.

John P. Risque

Philip H. Conniff, whose appointment as assistant superintendent of motive power and machinery of the Florida East Coast, with headquarters at St. Augustine, Fla., has already been announced in these columns, was born on April 10, 1871, in Trumbull County, O., and was educated in the public schools of Allegheny County, Pa. In April, 1891, he entered the service of the Pittsburgh & Lake Erie at McKees Rocks, Pa., and left that road in 1896, to go to the Pennsylvania Lines West as a machinist at the Allegheny, Pa., shops. He was promoted in 1898, to assistant roundhouse foreman and in 1900 was transferred to Ashtabula as general foreman. The following year he returned to the Allegheny shops as general roundhouse foreman. In January, 1902, he entered the service of the Baltimore & Ohio as general foreman at Lorain, Ohio, and in 1906, was promoted to master mechanic of the Wheeling division. He was trans-

P. H. Conniff

ferred to the Washington Terminal Company in charge of the locomotive department in 1908, and was appointed master mechanic of the Connellsville division of the Baltimore & Ohio in 1910. The following year he was appointed master mechanic of the Cumberland division of the same road. In June, 1912, he was transferred to Baltimore, Md., as superintendent of the locomotive and car departments at the Mt. Clare shops, and left the service of that road in January of this year to go to the Florida East Coast as assistant superintendent of motive power and machinery as above noted.

H. J. Warthen, master mechanic of the Richmond, Fredericksburg & Potomac at Richmond, Va., has been appointed superintendent of motive power, succeeding W. F. Kapp, resigned. Mr. Warthen will continue to perform the duties of master mechanic at Potomac yard.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

A. Brown, locomotive foreman of the Canadian Pacific at Ft. William, Ont., has been promoted to district master mechanic at Winnipeg, Man., succeeding A. Peers, transferred.

J. L. Brummel has been appointed road foreman of engines of the Minneapolis & St. Louis at Monmouth, Ill.

T. W. Coe, superintendent of shops of the New York Central west of Buffalo, at Elkhart, Ind., has been appointed master mechanic of the Indiana Harbor Belt, with headquarters at Gibson, Ind., in charge of the machinery and car departments.

B. B. Eidson, formerly road foreman of locomotives of the Grand Trunk at Smithers, B. C., has been appointed road foreman of locomotives at Regina, Sask.

W. B. Embury, master mechanic of the Chicago, Rock Island & Pacific at Valley Junction, Iowa, has been transferred to Estherville, Iowa, succeeding W. T. Fitzgerald.

W. T. Fitzgerald, master mechanic of the Chicago, Rock Island & Pacific at Estherville, Iowa, has been transferred to Manly, Iowa.

Wm. Gemlo has been appointed road foreman of engines of the Minneapolis & St. Louis at Watertown, South Dakota.

R. Haylor has been appointed road foreman of engines of the Minneapolis & St. Louis at Fort Dodge, Iowa.

R. C. Hyde, master mechanic of the Chicago, Rock Island & Pacific at Manly, Iowa, has been transferred to Valley Junction, Iowa.

M. F. McCarra has been appointed master mechanic of the Illinois Southern, with office at Sparta, Ill., succeeding G. A. Gallagher, deceased.

P. C. Moshisky, joint foreman of the Denver & Rio Grande at Durango, Col., has been appointed master mechanic, with headquarters at Ridgway, Col., succeeding J. A. Edwards, resigned.

A. Peers has been appointed district master mechanic, district 2, Saskatchewan Division of the Canadian Pacific at Moose Jaw, Sask., succeeding J. Neill.

W. J. Renix, heretofore district master mechanic of the Canadian Pacific at Calgary, Alta, has been appointed district master mechanic, district 1, British Columbia division, at Revelstoke, B. C., succeeding L. Fisher, assigned to other duties.

A. J. Roberts, formerly locomotive foreman of the National Transcontinental at Transcona, Man., has been appointed district master mechanic, district 2, at that place, succeeding A. Devine.

J. P. Stow, Jr., has been appointed master mechanic of the New London division of the New York, New Haven & Hartford, with headquarters at Midway, Conn.

S. West, formerly district master mechanic of the Canadian Pacific at Kenora, Ont., has been appointed district master mechanic at Medicine Hat, Alta., succeeding R. Brown, who has received a commission as lieutenant for overseas service.

James B. Wyler has been appointed master mechanic of the Midland division of the New York, New Haven & Hartford at Boston, Mass.

CAR DEPARTMENT

W. Jones has been appointed assistant foreman in charge of freight car repair yards of the National Transcontinental at Transcona, Man.

W. Mills has been appointed car foreman in charge of all work at Transcona yards of the National Transcontinental at Transcona, Man.

C. A. Munro, formerly car foreman of the Grand Trunk at Edson, Alta., has been appointed car foreman at Melville, Sask., succeeding W. Mills, resigned.

B. Woodcock, formerly car inspector of the Grand Trunk at Melville, Sask., has been appointed car foreman at Edson, Alta., succeeding C. A. Munro, transferred.

SHOP AND ENGINE HOUSE

George W. Armstrong, assistant shop superintendent for the Erie at Susquehanna, Pa., has been promoted to superintendent of the central manufacturing plant at Meadville, Pa.

P. S. Beatt, formerly locomotive foreman of the Canadian Pacific at Coronation, Alta., has been appointed locomotive foreman at Ogden, Alta.

A. W. Clark, formerly locomotive foreman of the Canadian Pacific at Kamloops, B. C., has been appointed locomotive foreman, Brandon, Man., succeeding G. Twist, transferred.

G. Clissold, formerly night locomotive foreman of the Canadian Northern, has been appointed assistant foreman at Rainy River, Ont., succeeding E. R. Mills, promoted.

J. N. Duncanson, formerly assistant locomotive foreman of the Canadian Northern at Winnipeg, Man., has been appointed locomotive foreman at Dauphin, Man., succeeding J. W. Skinner.

H. Herlick has been appointed locomotive foreman of the Canadian Pacific at Coronation, Alta., succeeding P. S. Beatt, transferred.

R. N. Millice has been appointed assistant locomotive superintendent of the United Railways of Havana at Cienaga, Havana. Mr. Millice gained his first experience in his father's machine shop at Topeka, Kan., and afterwards spent four years in the shops of the Santa Fe at that place. In 1900 he went to the Mexican Central, working successively as draftsman, efficiency expert, general foreman and master mechanic. He went to the Mexican Railroad Company in 1909 at Orizaba, where he remained until 1911, when he left the railway field.

E. R. Mills, formerly assistant foreman of the Canadian Northern at Rainy River, Ont., has been appointed locomotive foreman at Dauphin, Man., succeeding J. Duncanson.

C. H. Moulton, formerly acting road foreman of locomotives, district 3, of the National Transcontinental at Redditt, Ont., has been appointed locomotive foreman at Transcona, Man., succeeding A. J. Roberts promoted, and his former position has been abolished.

B. T. PATTERSON, formerly machinist of the Canadian Northern, has been appointed night locomotive foreman at Rainy River, Ont., succeeding G. Clissold, promoted.

E. A. PETTIT has been appointed general foreman of the locomotive shops of the New York Central West at Elkhart, Ind., succeeding H. E. Warner, promoted.

W. SHEPHERD has been appointed locomotive foreman of the Canadian Northern at Portage la Prairie, Man., succeeding S. Hicks.

W. F. SMALLWOOD has been appointed locomotive foreman, temporarily, of the Intercolonial Railway, at Newcastle, N. B., a new position.

G. TWIST, formerly locomotive foreman of the Canadian Pacific at Brandon, Man., has been appointed locomotive foreman, Fort William, Ont., succeeding A. Brown, promoted.

H. E. WARNER has been appointed superintendent of shops of the New York Central West, at Elkhart, Ind. He was born on March 2, 1872, and was educated in the grammar schools of Elkhart and took a course of mechanical engineering in the International Correspondence Schools. He began his railway work as an apprentice on the Lake Shore & Michigan Southern, at Elkhart on May 7, 1888. Later he was a machinist at Elkhart and at various contract shops throughout the country. He later returned to Elkhart as a machinist and was appointed piece work inspector in 1904. Since that time he has held the positions of shop inspector and general foreman, being appointed to his present position on March 1, 1916.

J. J. WENZEL, formerly assistant roundhouse foreman of the New York Central West at Air Line Junction, Ohio, has been appointed erecting shop foreman at Elkhart, Ind., succeeding E. J. Pettit, promoted.

W. H. WORTMAN, formerly general foreman of the Canadian Pacific at Ogden, Alta., has been appointed locomotive foreman at Calgary, Alta., succeeding J. Neill, transferred.

OBITUARY

WILLIAM H. ELLIOTT, formerly fuel agent of the New York, New Haven & Hartford, died on March 2, at his home in New Haven, Conn., at the age of 63.

CHARLES F. ROBERTS, assistant locomotive superintendent of the United Railways of Havana, died on March 8 at his home in Cienaga. Mr. Roberts was born in Wilkes-Barre, Pa., 38 years ago, and served on railways in the United States, Mexico and Ecuador before going to Cuba.

G. A. GALLAGHER, master mechanic at the Illinois Southern at Sparta, Ill., died in that city on February 24 of pneumonia.

ROBERTS LAWRIE STEWART, mechanical superintendent of the Second district of the Chicago, Rock Island & Pacific at El Reno, Okla., died suddenly at Kansas City, Mo., on March 24, at the age of 50. He was born March 22, 1866, at Tyrone, Pa., and was educated in the public schools and at Cornell University. He entered the service of the Denver & Rio Grande in 1885 as machinist apprentice and after completing his course was appointed roundhouse foreman, leaving that road in 1905. He was employed later by the Atchison, Topeka & Santa Fe, the Kansas City Southern and the Chicago, Rock Island & Pacific as general foreman and master mechanic. On June 1, 1914, he was promoted to mechanical superintendent of the Third district of the Chicago, Rock Island & Pacific at El Reno, Okla., and on January 1, 1916, his jurisdiction was extended to cover a portion of the old Second district when it was consolidated with the First and Third districts. Mr. Stewart was in active service up to the time of his death.

SUPPLY TRADE NOTES

W. G. Willcoxson has been appointed sales representative of the Boss Nut Company, with headquarters at Chicago, Ill.

Edwin H. Baker, second vice-president of the Galena Signal Oil Company, has retired from that position after having been engaged in the manufacture and supply of lubricating oils for 43 years.

Charles Morgan Hewitt, chairman of the board of directors of the Magnus Company, Inc., and president of the Hewitt Company, both of Chicago, died at Palm Beach, Fla., on March 16, after a prolonged illness.

The Sherritt & Stoer Company, Inc., 603 Finance building, Philadelphia, Pa., has been appointed exclusive sales agents in the Philadelphia district for the Beaudry Champion and Peerless power hammers made by Beaudry & Co., Inc., Boston, Mass.

Frank G. Wallace, of Pittsburgh, Pa., for many years a director of the Canadian Locomotive Company, Ltd., Kingston, Ont., has been appointed managing director of that company, and William Casey, hitherto assistant general manager, has been appointed manager.

H. A. Gray has been appointed assistant manager railroad sales of Joseph T. Ryerson & Son, with jurisdiction over Eastern railroad and machinery sales, with headquarters at New York. All branches of the sales and operating departments will be directed as heretofore, from Chicago.

L. E. Jordon, president and general manager of the Vulcan Process Company, Inc., Minneapolis, Minn., has disposed of his interest in the company and has been succeeded in office by Clifford N. Lockwood, who will have the position of treasurer and general manager. The Vulcan Process Company, Inc., deals in oxy-acetylene apparatus and supplies.

George E. Fox, formerly southeastern representative of the Curtain Supply Company, has been appointed western sales agent of the same company, with headquarters in Chicago. T. P. O'Brian has been appointed southeastern sales agent, with headquarters at New York City. Mr. O'Brian has been with the O. M. Edwards Company of Syracuse, N. Y., for a number of years.

Ralph G. Coburn, for the last few years eastern sales manager of the Franklin Railway Supply Company, has been appointed sales manager of the electrical department of that company, now handling the Stone-Franklin lighting equipment. Mr. Coburn has been with the Franklin Railway Supply Company for the past seven years, and was at one time in charge of its Chicago office. His headquarters will be in New York.

The Quigley Furnace & Foundry Company, Springfield, Mass., having recently added to its business a brass rolling mill department for the production of flat brass, the stockholders of the company, at the annual meeting on January 26, decided to adopt a new and more comprehensive name, the Metals Production Equipment Company. No change has been made in general policy or management. The furnace, foundry and powdered coal departments will be continued as heretofore.

Holden & White is the name of a new firm formed by R. R. Holden, formerly with the Wesco Supply Company, of St. Louis, Mo., and recently a manufacturer's agent in Chicago, and W. McK. White, former sales manager of the Esterline Company, of Indianapolis, Ind. The new company will represent a number of manufacturers of railway materials and equipment, and has arranged for affiliated representation in 15 cities in the United States and Canada. The company has opened offices in the Fisher building, 343 South Dearborn street, Chicago, Ill.

H. E. Creer, who for the past five years has been associated with McCord & Co., of New York and Chicago, has resigned to become eastern sales agent for the Union Railway Equipment Company, with headquarters in the McCormick building, Chicago, Ill. B. H. Forsyth, who for three years has been a member of the sales force of the Hale & Kilburn Company, has been appointed western sales agent of the Union Railway Equipment Company, with offices in the McCormick building, Chicago. Mitchel A. Evans, formerly associated with the Railway Appliances Company, has been appointed sales agent, with headquarters in the McCormick building, Chicago.

G. H. Groce has entered upon his new duties as head of the railway department of the Electric Storage Battery Company of Philadelphia, with headquarters at Chicago. Mr. Groce was born at Tarentum, Pa., February 19, 1864. He was educated in the public schools, and in 1880 became a telegraph operator on the Pittsburgh & Lake Erie. After two years' service on that road, he was for one year an operator on the Baltimore & Ohio, and then returned to the Pittsburgh & Lake Erie as freight and ticket agent and train despatcher. From 1885 to 1897 he held positions with various roads as train despatcher, chief train despatcher and chief clerk in the general superintendent's office. In 1897 he became superintendent of telegraph of the Baltimore & Ohio Southwestern, and from 1899 to 1901 was superintendent of the Springfield division of that road. In 1902 he became southwestern agent of the Taylor Signal Company at St. Louis. He returned to railway work the following year, serving from 1903 to 1910 as superintendent of telegraph and assistant to the general manager of the Illinois Central. From 1910 to 1912 he was assistant to the president of the General Railway Signal Company, and for the following two years was vice-president of the Wright Telegraphic Typewriter Company. For the past year he has been engaged in special work for the General Railway Signal Company.

Walter H. Bentley, who has been appointed assistant to the president of Mudge & Co., Chicago, Ill., was born in Chester, England, in 1888. He came to America in 1892, and was educated in the public schools at Oak Park, Ill. In 1903 he entered the service of the Chicago & North Western as an employee of the storekeeping department. From 1903 to 1908 he was in the maintenance of way department of the same railroad. In 1909 he entered the employ of the Duluth & Iron Range as a locomotive fireman, returning to the North Western in December of the same year. From that time until May, 1913, he worked in various capacities in the maintenance of way department, the pension department, the superintendent's office and the purchasing department. He became a member of the Chicago sales force of the Baldwin Locomotive Works and the Standard Steel Works upon leaving the North Western. In April, 1914, he became western representative of the Curtain Supply Company, and on March 1, 1916, was appointed assistant to the president of Mudge & Company, of Chicago.

Walter H. Bentley

Catalogues

Electric Hammer Drills.—Bulletin E-38 issued February 1 by the Chicago Pneumatic Tool Company, describes the Duntley universal electric hammer drill manufactured by that company.

Forging Machines.—The National Machinery Company, Tiffin, Ohio, in National Forging Machine Talk No. 8 describes the new method used in the company's heavy-pattern forging machines of alining heading slides.

Testing Machines.—Catalogue No. 93 recently issued by the Watson-Stillman Company, Aldene, N. J., describes in detail the Sturcke-Watson-Stillman testing machine for cylindrical gas containers. The booklet describes and illustrates the machine and explains its uses and possibilities.

Tungsten Mining in Colorado.—A folder bearing this title, recently issued by the Vanadium-Alloys Steel Company, Pittsburgh, Pa., contains a reprint of an article on this subject written by Roy C. McKenna, the president of the Company, which appeared in the Iron Trade Review.

Electrical Apparatus.—One of the recent publications of the railway and lighting department of the Westinghouse Electric & Manufacturing Company is an illustrated booklet containing a paper presented before the Railway Club of Pittsburgh by E. M. Herr, entitled "Notes on Electric Power Development."

Machine Tools.—The Niles-Bement-Pond Company has recently issued four folders relative to its machine tools. Circular No. 101 illustrates and describes a 48-in. car wheel borer; circular No. 102, a center drive car wheel lathe; circular No. 103, a 36-44 in. side head boring mill, and circular No. 104 a 90-in. driving wheel lathe, heavy pattern.

Industrial Locomotives.—The Bell Locomotive Works, 30 Church street, New York, in Record No. 7, illustrates and describes its line of industrial steam locomotives burning liquid fuel. These locomotives burn fuel-oil, distillate or gasolene, etc., and have been supplied for use on sugar plantations, in tunnel construction, in industrial plants and mines, on logging railroads, and for similar purposes.

Lighting and Heating Burners.—The Alexander Milburn Company, Baltimore, Md., has recently issued a 12-page booklet describing and illustrating the Wells Light and Heating Burner. This burner, which until June, 1915, was handled by the Wells Light Manufacturing Company, Jersey City, N. J., burns kerosene oil and is adapted for contractors, railroads, industrial plants, foundries, ship yards, etc.

Refrigeration, Ventilation and Heating of Cars.—The Refrigerator, Heater & Ventilator Car Company of St. Paul, Minn., has issued a 64-page booklet explaining the Moore system of heating, cooling and ventilating cars and pointing out the economies which obtain from its use. It also contains 41 testimonials to the merits of the system received from companies which are using it in their cars.

Wiring Devices.—The Bryant Electric Company, Bridgeport, Conn., has issued an elaborate catalogue of 168 pages containing illustrations, descriptions, list prices, etc., of the company's line of Superior wiring devices. In the catalog there are illustrated "New Wrinkle" and "Wrinklet" sockets and other fixtures and various types of switches, receptacles, plugs and similar fixtures. The book is very well gotten up and profusely illustrated.

Storage Battery Cars.—The Railway Storage Battery Car Company, New York, has issued a booklet entitled Self-Propelled Passenger Cars. The booklet contains views and plans of cars which have been supplied for city and

suburban service. The cars are equipped with the Edison non-acid storage battery, and are supplied for both steam railroads and electric railways.

HOISTS AND DERRICKS.—The Minneapolis Steel & Machinery Company, Minneapolis, Minn., has published a 112-page catalogue describing its steam and electric hoisting engines, tractors, derricks, hoists and miscellaneous material used for hoisting purposes. The catalogue is fully illustrated and goes into considerable detail as to the mechanical parts of the hoists and derricks.

FREIGHT CARS.—The Ralston Steel Car Company, Columbus, Ohio, has recently issued a loose-leaf binder containing copies of bulletins showing cars which this company has built for various railroads and other owners of freight cars. Each bulletin illustrates one or more cars and gives a very brief description and general information relative to each car. The illustrations are extremely clear and the binder and its contents very attractively gotten up.

FOUNDRY EQUIPMENT.—Catalogues No. 118 and No. 119, recently issued by the Whiting Foundry Equipment Company, Harvey, Ill., deal respectively with the Whiting cupola and the company's line of air hoists. In the latter booklet the air hoists are described in detail, views being shown of the several hoists and of typical installations. The catalogue describing the Whiting cupola shows sectional and other views, and typical installations of the apparatus in connection with an explanation of the features of the cupola's design.

CONDUIT CHART.—The National Metal Molding Company, Pittsburgh, Pa., manufacturers of electrical conduits and fittings, is distributing an attractive wall hanger, reproducing, in one-half actual size, conduit charts as adopted and recommended by the National Electrical Contractors' Association, showing sizes of conduit required by the National Electrical Code for carrying various sizes of conductors. This hanger is printed on linen-backed stock and will prove of convenience for reference in the offices of architects, engineers and electrical contractors.

BEARINGS.—The Norma Company of America, New York, has recently issued catalogue No. 105 describing and illustrating and giving list prices of the Norma precision bearings made by the company. A large part of the booklet is devoted to a description of the Norma ball bearing. The various types of bearing are shown in halftone and line illustrations and the accompanying reading matter discusses the design of the bearing and its advantages for various kinds of service. A large part of the booklet is devoted to lists of bearings giving the dimensions, types and list prices.

TIMBER FOR STRUCTURAL PURPOSES.—The Structural Timber department of the National Lumber Manufacturers' Association, Chicago, has issued the first of a series of engineering publications on structural timber. This book of 20 pages discusses briefly the need for engineering information concerning timber. It also contains much information of value regarding the available supply of timber, its relative cost and its suitability for modern forms of mill or other construction, and serves to introduce later bulletins which will deal more specifically with the various phases of structural timber.

STORAGE BATTERIES.—Two of the recent publications of the Edison Storage Battery Company are entitled, respectively, "The Edison Alkaline Storage Battery" and "Edison Alkaline Storage Batteries and Some of Their Applications." The former booklet has been issued as Monograph III of the National Education Association Joint Committee Series. It describes the manufacture of the Edison batteries—and in one of its chapters takes the reader on a trip through the factory in Orange, N. J. The booklet also touches upon some of the characteristics of the battery, dealing with its chemistry, its advantages, its approach to the ideal battery, etc. The other bulletin mentioned considers the possible use of Edison batteries and their advantages for various kinds of service. Both booklets are illustrated.

WELDING.—The Goldschmidt Thermit Company, 90 West street, New York, has recently issued three attractive bulletins relative to the Thermit process of welding. One is a folder, treating in a somewhat general way of the subject of locomotive repairs. The other two are much more elaborate and are entitled respectively: "Thermit Locomotive Repairs" and "Thermit Mill and Foundry Practice." These books contain instructions for the use of Thermit and are illustrated with drawings and other views showing the necessary steps to be taken. There are also a number of views showing the results which may be obtained.

CENTRIFUGAL PUMPS.—The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has recently issued pamphlets describing its centrifugal pumps and pumping units, and a summary of tests on a 10-in. centrifugal pump. In these tests the maximum efficiency of 85 per cent. was reported. The pamphlet describing the centrifugal pumping units shows cross section illustrations of the various types of pumps manufactured by that company, describes the construction and gives the reports of tests made with the different types. Illustrations of test plants and various pump installations are also included.

LOCOMOTIVE DEVICES.—The Franklin Railway Supply Company has recently issued an attractive and well illustrated booklet describing and illustrating in half-tones and line drawings the McLaughlin flexible conduit, Franklin ball joints and the Franklin single water joint. The McLaughlin flexible conduit is an all-metal connection for use between engine and tender, etc., for air, steam and oil lines. When assembled it consists of two double joints, one single joint and two lengths of extra heavy wrought iron pipe. The Franklin ball joint is intended to replace rubber hose for use in roundhouses or for heating coaches in terminals or coach yards. The single water joint is designed for injector connections.

ELECTRICAL SUPPLIES.—The Western Electric Company's 1916 year book, which is now being distributed to the trade, contains 1,504 pages, nearly 300 pages more than the first edition of the Electrical Supply Year Book which the company published on January 1, 1915. The book contains illustrations and list prices of the extensive lines of electrical equipment which are sold by the company, and like the 1915 year book, it is characterized by list prices which are subjected with very few exceptions to a single discount for all the lines included. The Western Electric Company announced last year that it was its intention in the future to revise its catalogue yearly, and the present edition is a result of that policy.

BOILERS.—The Harrison Safety Boiler Works, Philadelphia, Pa., has recently issued a 68-page catalogue entitled "Finding and Stopping of Waste in Modern Boiler Rooms." The book treats of the value of feed water and condensate meters as aids in the management of power plants and it is shown how with a feed water meter one can ascertain the results of various factors, such as grade of fuel, grates, methods of firing, air leaks, control of draft, condition of gas passages, scale and soot on boiler tubes, radiation, etc. The point is made that the use of records which may be obtained with the meters arouses the ambition and spirit of emulation of the men, and makes it possible to reward special skill or attention to duty, as by bonuses or promotions. A section of the book also treats of the Cochrane metering heater (combined open feed water heater and hot water heater) with its several modifications. The Cochrane flow recorder for use in connection with V-notch weirs and a new type of meter working on the volumetric principle are also described. The book is well illustrated.


Heavier trains mean increased dividends
The average gross earnings on all American Railroads, during 1913, was $153 per locomotive per day, which, at an operating ratio of 71.33 per cent, gives a net earning of $44 per day.
A superheated locomotive will haul at least 15 per cent more tonnage than a similar saturated engine, without any increase in operating costs.
In other words, this increased tonnage represents clear profit, as it is based on the gross earnings of the locomotive, but is not subject to the operating ratio.
On this basis, by applying a superheater to a saturated locomotive, and utilizing only 75 per cent of the full power thus obtained, there will be an increased net earning of $\frac{75 \times 15}{100} \times 153 =$ $17.20 per engine per day, which amounts to an increased net earning of over $5,500 per engine per year.
This represents an increase of almost 40 per cent in net revenue earned by the locomotive.
Locomotive Superheater Co.
30 Church Street, New York
Peoples Gas Building, Chicago